Minerals Yearbook

1977

Volume III

AREA REPORTS: INTERNATIONAL

Prepared by staff of the

BUREAU OF MINES

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UNITED STATES DEPARTMENT OF THE INTERIOR • James G. Watt, Secretary

BUREAU OF MINES

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities to protect and conserve our land and water, energy and minerals, fish and wildlife, and park and recreation areas, and for the wise use of all those resources. The Department also has a major responsibility for American Indian reservation communities and for the people who live in Island Territories under U.S. administration.

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Foreword

The Federal Government, through the Minerals Yearbook and its predecessor volumes, has reported annually on mineral industry activities for 96 years. This edition discusses the performance of the worldwide mineral industry during 1977. In addition to statistical data, the volumes provide background information to assist in interpreting the year's developments. Content of the individual volumes follows:

Volume I, Metals and Minerals, contains chapters on virtually all metallic and nonmetallic mineral commodities important to the domestic economy. In addition, it includes a general review chapter on the mineral industries, a chapter on mining and quarrying trends, and a statistical summary.

Volume II, Area Reports: Domestic, contains chapters on the mineral industry of each of the 50 States, the U.S. island possessions in the Pacific Ocean and the Caribbean Sea, and the Commonwealth of Puerto Rico. This volume also has a statistical summary, identical to that in Volume I.

Volume III, Area Reports: International, contains the latest available mineral data on more than 130 foreign countries and discusses the importance of minerals to the economies of these nations. A separate chapter reviews the international minerals industry in general and its relationship to the world economy.

The Bureau of Mines continually strives to improve the value of its publications to its users. Therefore, the constructive comments and suggestions of readers of the Yearbook will be welcomed.

Director

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Acknowledgments

The Bureau of Mines, in preparing this volume, utilized extensively statistical and other basic data on mineral production, consumption, and trade provided by various foreign government mineral and statistical agencies through a variety of official publications. The cooperation and assistance of these agencies is gratefully acknowledged. Statistical and informational material was also obtained from airgrams of the U.S. Department of State, from United Nations publications, and from the domestic and foreign technical and trade press. Of particular help in preparing this volume were the routine and special reports submitted by the minerals, petroleum, economic, and commercial officers and other members of the Department of State. Their contributions are sincerely appreciated.

The text and tables of this volume were prepared by the staff of the Branch of Foreign Data, Division of Production/Consumption Data Collection and Interpretation. Final correlation and checking of this volume were performed by the Branch of Publication Support Services of the Division of Publication.

The regimes of some countries reviewed in this volume are not recognized by the U.S. Government. The information contained herein is technical and statistical in nature and is not construed as conflicting with or being contradictory of U.S. policies toward these countries.

Albert E. Schreck, *Editor-in-Chief*

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Contents

	Page
Foreword	iii
Acknowledgments, by Albert E. Schreck	v
Minerals in the World Economy, by Charles L. Kimbell	1
Ocean Minerals, by William T. Cocke	29
Afghanistan, by E. Shekarchi	39
Albania, by George Rabchevsky	43
Algeria, by David E. Morse	53
Angola, by Janice L. W. Jolly	63
Argentina, by Orlando Martino	69
Australia, by Charlie Wyche	83
Austria, by William F. Keyes	111
Belgium-Luxembourg, by William F. Keyes	125
Bolivia, by Orlando Martino	141
Botswana, by Janice L. W. Jolly	151
Brazil, by Orlando Martino	155
Bulgaria, by Tatiana Karpinsky	181
Burma, by Gordon L. Kinney	193
Canada, by Water C. Woodmansee	201
Chile, by George J. Coakley	213
China, People's Republic of, by K. P. Wang	223
Colombia, by Orlando Martino	249
Cyprus, by T. John Rowland, Jr.	261
Czechoslovakia, by Tatiana Karpinsky	267
Denmark and Greenland, by Joseph B. Huvos	283
Egypt, by Candice Stevens	295
Finland, by Joseph B. Huvos	305
France, by Roman V. Sondermayer	317
Gabon, by Candice Stevens	341
German Democratic Republic, by George Rabchevsky	347
Germany, Federal Republic of, by Joseph B. Huvos	365
Ghana, by T. John Rowland, Jr.	389
Greece, by Roman V. Sondermayer	393
Greenland (see Denmark and Greenland)	
Hungary, by George Rabchevsky	405

Digitized by Google

	Page
Iceland, by Joseph B. Huvos	433
India, by Gordon L. Kinney and Francis E. Shafer	439
Indonesia, by K. P. Wang	463
Iran, by Janice L. W. Jolly	479
Iraq, by David E. Morse	493
Ireland, by William F. Keyes	501
Israel, by David E. Morse	511
Italy, by Roman V. Sondermayer	519
Japan, by E. Chin	537
Kenya, by Janice L. W. Jolly	561
Korea, North, by E. Chin	569
Korea, Republic of, by E. Chin	577
Kuwait, by T. John Rowland, Jr.	589
Liberia, by Janice L. W. Jolly	595
Libya, by T. John Rowland, Jr.	603
Luxembourg (see Belgium-Luxembourg)	
Madagascar, by David E. Morse	607
Malaysia, by E. Chin	613
Malta, by Roman V. Sondermayer	627
Mauritania, by Candice Stevens	629
Mexico, by Doris M. Hyde	633
Morocco, by Janice L. W. Jolly	649
Mozambique, by David E. Morse	661
Netherlands, by William F. Keyes	665
New Zealand, by Walter C. Woodmansee	681
Nigeria, by Janice L. W. Jolly	691
Norway, by Joseph B. Huvos	703
Pakistan, by David E. Morse	721
Peru, by Orlando Martino	727
Philippines, by K. P. Wang	743
Poland, by Tatiana Karpinsky	757
Portugal, by Roman V. Sondermayer	773
Rhodesia, Southern, by Janice L. W. Jolly	785
Romania, by George Rabchevsky	793
Saudi Arabia, by Candice Stevens	811
Sierra Leone, by Candice Stevens	821
South Africa, Republic of, by Miller W. Ellis and Charles W. Sweetwood	825
South-West Africa, Territory of, by Candice Stevens	849
Spain, by Roman V. Sondermayer	855
Sudan, by Candice Stevens	873
Sweden, by Joseph B. Huvos	879
Switzerland, by Roman V. Sondermayer	893
Taiwan, by E. Chin	905
Tanzania, by David E. Morse	919
Thailand, by Gordon L. Kinney	925
Tunisia, by E. Shekarchi	939
Turkey, by T. John Rowland, Jr.	947
U.S.S.R., by V. V. Strishkov	959
United Arab Emirates, by Candice Stevens	1027
United Kingdom, by William F. Keyes	1033
Venezuela, by Doris M. Hyde	1057

Digitized by Google

	Page
Yugoslavia, by Roman V. Sondermayer	1069
Zaire, by Miller W. Ellis	1087
Zambia, by Miller W. Ellis	1093
Other Areas of Africa (Bénin, Burundi, Cameroon, Cape Verde Islands, Central African Empire, Chad, Comoros, Congo, Djibouti, Equatorial Guinea, Ethiopia, The Gambia, Guinea, Guinea Bissau, Ivory Coast, Lesotho, Malawi, Mali, Mauritius, Niger, Réunion, Rwanda, São Tomé e Principe, Senegal, Seychelles, Somalia, Swaziland, Togo, Uganda, Upper Volta), by Staff, Branch of Foreign Data	1101
Islands of the Caribbean (Bahamas, Barbados, Bermuda, Cuba, Dominican Republic, Haiti, Jamaica, Martinique and Guadeloupe, Netherlands Antilles, St. Lucia, Trinidad and Tobago), by Doris M. Hyde	1131
Central American Countries (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama), by Staff, Branch of Foreign Data	1153
Other Areas of the Far East and South Asia (Bangladesh, Brunei, Hong Kong, Kampuchea, Laos, Mongolia, Nepal, Singapore, Sri Lanka Vietnam), by Staff, Branch of Foreign Data	1173
Other Countries of the Near East(Bahrain, Jordan, Lebanon, Oman, Qatar, Syria, People's Domocratic Republic of Yemen, Yemen Arab Republic), by Staff, Branch of Foreign Data	1207
Other Areas of South America (Ecuador, French Guiana, Guyana, Paraguay, Surinam, Uruguay), by Doris M. Hyde	1225
Other South Pacific Islands (British Solomon Islands, Christmas Island, Fiji, Nauru and Ocean Island, New Caledonia, New Hebrides, Papua New Guinea, Tonga), by Walter C. Woodmansee	1233

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Minerals in the World Economy

By Charles L. Kimbell[1]

The year 1977 generally was a year of growth in overall world mineral industry activity, although there were downturns in major elements of the world's iron and steel industries. The sharp upturns in market economy nation activities that were noted in 1976, following the reduced performance levels of 1975, were moderated, and in the centrally planned economy nations, overall mineral industry activity apparently continued to increase, but at a pace in keeping with that of 1976 rather than at the higher rates of the earlier 1970's.

Noteworthy during the year, if only in a negative sense, was the inability of world powers to reach any significant agreement on issues relating to deep seabed mining. Interest from a commercial viewpoint centered around deposits or so-called manganese nodules. These materials, which indeed are chiefly manganese in terms of their content on a quantitative basis, really were of commercial interest primarily for their copper, nickel, and cobalt content. Participants at the Third United Nations Law of the Sea Conference looked into seabed mining rights, but reached no mutually agreeable decisions.

PRODUCTION

The estimated value of world crude mineral production in 1977 was $197,600 million in terms of constant 1973 dollars, about 5% above the revised 1976 level of $188,200 million. The value increase was somewhat higher than the actual quantitative increase, however, because of higher unit prices in 1977 than in 1976. The following tabulation summarizes approximate data on value of world mineral production for selected years:

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Year	Billion constant 1973 dollars	
	Value of 53[1] major crude mineral commodities[2]	Value of all crude mineral commodities[3]
1950	46.2	52.6
1953	60.3	69.3
1958	77.4	93.0
1963	85.6	104.9
1968	99.2	120.2
1973	159.2	189.6
1974	162.0	183.7
1975	159.2	178.1
1976	167.6	188.2
1977	175.9	197.6

[1]The list of commodities included appears in table 5 of the 1974 edition of this chapter; one commodity covered in 1950-68 (beryl) is excluded from the 1973-77 figures, but the overall impact of this omission is regarded as insignificant.
[2]Data for all years except 1974-77 are as reported in Annales des Mines, December 1975, p. 13; data for 1974-77 are extrapolated from the 1973 Annales des Mines figures on the basis of the United Nations index of extractive industry production in the United Nations Monthly Bulletin of Statistics, August 1979, p. xiv.
[3]Data extrapolated from those values for 53 commodities to compensate for commodities not included in the source of that data. For details on the basis of extrapolation, see relevant text in the 1974 edition of this chapter under "Value of World Mineral Production."

The foregoing data belittle the role of the mineral industry in the world economy, however, for they represent an approximation of the value of minerals in their crudest form—the actual production from mines, quarries, and wells—and not the enhanced value that results from beneficiation, smelting, refining, and other equivalent downstream processing. Further, no allowance is made in these values for the value added in transporting mineral materials from the production centers to those places where they are ultimately consumed. If the value added through processing—smelting of metals, refining of oil, and manufacture of basic materials such as cement and fertilizers—were included, a 1977 figure on the order of $470,000 million could be regarded as a conservative estimate of the value of output of primary mineral processing plants, to which a further as yet unestimated increment could be added for secondary metals processing. Moreover, it should be noted that the crude and processed mineral commodities constitute the overwhelming dominant share of the total raw material base for all manufacturing endeavors, as well as a significant requirement for the agricultural industries because of that industry's need for fertilizers of mineral origin.

PRODUCTION INDEX PATTERNS

The following tabulation summarizes the growth in world mineral industry output as reflected by the United Nations indexes for extractive mineral industry components:

Year	Index Numbers (1970=100)			
	Coal	Crude petroleum and natural gas	Metals	Total
1973	96	122	105	114
1974	96	125	107	116
1975	99	120	102	114
1976	100	130	105	120
1977	101	139	106	126

Source: United Nations. Monthly Bulletin of Statistics, August 1979, v. 33, No. 8, New York, 1979, p. xiv.

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Comparison between the world extractive industry indexes in the foregoing tabulation and the indexes for processing sectors of the mineral industry presented in the following tabulation demonstrate the substantially higher levels of growth in production value for downstream products:

Year	Index numbers (1970=100)		
	Nonmetallic mineral products	Chemicals, petroleum, coal and rubber products	Base metals
1973	124	129	128
1974	128	135	135
1975	126	131	133
1976	136	146	145
1977	141	155	155

Source: United Nations. Monthly Bulletin of Statistics, August 1979, v. 33, No. 8, New York, 1979, p. xv.

For details on differences in mineral industry index pattern growth for various world areas, the reader is referred to the source publication for the foregoing tabulations.

QUANTITATIVE COMMODITY OUTPUT

Total world production of 87 distinct mineral commodities and/or specific forms of mineral commodities is given in table 1 for 1975-77. Of these commodities, 65 registered gains and 22 recorded declines in 1977 relative to 1976 output levels, compared with 62 reporting gains and 25 recording declines between 1975 and 1976. Of the 45 metal commodities listed, 31 were produced in greater quantities in 1977 than in 1976; of the 31 nonmetal commodities recorded, 24 were produced at higher levels in 1977 than in 1976; and among the 11 fuels listed, all but one were produced in greater quantities in 1977 than in 1976. Probably the most notable declines in output in 1977 were those recorded for iron ore, pig iron, ferroalloys, and crude steel.

No viable means exists to sum up the overall production performance of the nonfuel mineral industry, and for these commodities, exactitudes on value are not available for detailed review. Among the fuel commodities, however, a pattern of overall growth can be demonstrated by United Nations data in which all fuels are reduced to a common energy equivalent basis. The following tabulation summarizes world energy output for 1973-77:

Year	Million metric tons, standard coal equivalent				
	Coal	Crude petroleum and natural gas liquids	Natural gas	Hydro and nuclear electricity	Total
1973	2,426	4,247	1,539	186	8,398
1974	2,457	4,261	1,560	209	8,487
1975	2,577	4,054	1,568	224	[1]8,422
1976	2,650	4,381	1,633	232	8,896
1977	2,763	4,569	1,671	250	[1]9,254

[1]Data may not add to totals shown because of independent rounding.

Source: United Nations. World Energy Supplies 1973-78. Statistical Papers, Series J, No. 22, New York 1979, p. 14.

Total output of energy in all forms increased 4% between 1976 and 1977, compared with an increase of 5.6% between 1975 and 1976.

TRADE

In 1977, the aggregate value of total world trade in mineral commodities reached $386,300 million, an increase of nearly 10% from the previous record high set in 1976. The following tabulation summarizes the growth pattern in mineral commodity trade for 1970-77:

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Year	Estimated value of all mineral commodities traded[1] (millions)	Change from previous year (percent)	Mineral commodities share of all commodities traded (percent)
1970	$83,558	+17.4	26.8
1971	[r]91,191	+9.1	26.3
1972[r]	103,760	+13.8	25.1
1973	[r]151,800	[r]+46.3	26.5
1974[r]	324,900	+114.0	38.8
1975[r]	312,100	-3.9	35.8
1976	352,700	+13.0	35.7
1977	386,300	+9.5	34.4

[r]Revised.
[1]Value estimated from data on major mineral commodity trade appearing in table 5, to which has been added a factor for all mineral commodities not included in that table.

The phenomenal increases registered in the value of mineral trade in 1973 and 1974 and the continued high levels of 1975-77 almost exclusively reflect the huge growth in the price for fuels rather than any increase in the quantity of material being moved in trade. Between 1972 and 1973, when there was a 46.3% increase in value of exports, the weight of vessel loadings increased by only 13%, and between 1973 and 1974, when the export value increase was 114%, the growth in weight of vessel loadings was only 1.1%. The total amount of growth in mineral export value, of course, was not entirely directly the result of growth in fuel cost, but a significant share of the increase in value of nonfuel mineral exports was the result of higher energy costs involved in their production, processing, and transportation.

Viewing the decline in mineral trade value in 1975, it should be noted that the value drop of 3.9% was lower than the corresponding shortfall in quantity of goods loaded, which totaled almost 7.3%. Thus, while the growth rate for mineral commodity value as measured by mineral commodity exports was diminshed in 1975, it was by no means halted.

Moving on to 1976 and 1977, the growths of 13% and 9.5%, respectively, over the previous year, that were recorded for mineral commodity exports again were smaller than the 10.4% and 2.5% growths registered for weight of loadings of vessels in those years, reflecting again the continued upward trend of unit prices, first for fuels themselves and second for other mineral commodities, with the latter in part due to higher energy costs for their production, processing, and transport.

Table 2 provides data on the distribution of value of world mineral trade in major mineral commodity groups, and a comparison between the value of these major mineral commodity groups and the value of total commodity trade. The data in this table on trade in major mineral commodities also served as the basis for estimation of the value of total world mineral commodity trade which appears in the tabulation at the beginning of this section. Table 3 is self-explanatory, giving the distribution of value of world export trade in major mineral commodity groups by group. The consistent rise in the share of the total accounted for by mineral fuels during 1972-77 is the most noteworthy single fact shown.

Table 4 shows the change in value of each of the major mineral commodity groups, as well as of total commodity trade, during 1972-77 on the basis of percent change over the previous year.

In previous editions of this chapter, three additional tables on mineral trade were provided (see tables 8-10, in the 1976 edition). Limitations of time and staff precluded their preparation for inclusion in this chapter, but the reader may derive this data for himself from the June 1978 and May 1979 editions of the United Nations Monthly Bulletin of Statistics. Details provided by these tables included the role of major mineral commodity trade in total trade of various major world areas (table 8 in the 1976 edition), the distribution of exports and imports in each of the major mineral commodity groups by major areas of origin and destination (table 9, in the 1976 edition), and the distribution of total mineral commodity exports from each major region by region of destination (table 10 in the 1976 edition).

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CONSUMPTION

NONFUEL MINERAL COMMODITIES

Although time has not permitted a detailed compilation of data on world consumption of major mineral commodities, an upturn in consumption of most metals is suggested on the basis of partial data, and available reports on nonmetals suggest that use of most such materials also increased in 1977.

MINERAL FUEL COMMODITIES

Data published by the United Nations indicate that there was a 3.2% increase in worldwide energy consumption between 1976 and 1977, substantially below the 6.0% growth level between 1975 and 1976, but well ahead of the .3% increase between 1974 and 1975. The following tabulation summarizes world total mineral fuel consumption by major fuel types in recent years:

Year	Million metric tons of standard coal equivalent				
	Solid fuels	Liquid fuels	Natural and imported gas	Hydro, nuclear, and imported electricity	Total
1973	2,452	3,578	1,517	187	7,734
1974	2,489	3,535	1,545	210	7,779
1975	2,516	3,523	1,545	224	7,808
1976	2,646	3,770	1,633	231	8,280
1977	2,744	3,896	1,651	250	8,541

Although the share of the total accounted for by each of the listed fuels has altered only slightly during the five years covered by the tabulation, there were generally increases in the percentage share accounted for by solid fuels and by hydroelectric and nuclear power, over the total period, with compensatory declines in liquid fuels, and natural gas.

INVESTMENT

Available information on selected industrial sectors of market economy countries and on total U.S. mineral industry investment, together with general indications and spot reporting of individual investments in other world areas, indicate an increase in investment levels in 1977, at least in terms of current dollars. It is less than clear, however, whether these increases in current dollars represented any growth in investment in terms of tangible assets, because of the inflationary trend throughout the market economy world.

Moreover, not all mineral industry sectors registered increases in current dollar investments. Table 5 summarizes annual investment expenditures in the iron and steel industry in selected countries for 1975-77. In 1975, steel industry investment was over 10% below the 1974 level reflecting the sharp downturn in overall economic activity in 1975. The sharply higher figure for 1976 reflects both an increase in investment and the spiraling inflationary pattern, thus the apparent 50.7% increase did not buy 50.7% more equipment. The downturn in 1977 (9.6% below the 1976 level) was indicative of an even more significant decline in investment in terms of actual burning power because of the continued inflationary trend. Every country and country group represented in the table registered declines in current dollar investment level except Spain, Japan, and Turkey; and among these upturns, only that of Japan was really significant. This pattern reflected the generally poor economic condition of West European and American steel producers.

Table 6 provides data on total U.S. direct foreign investment by the mining, smelting,

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and refining industry and the petroleum industry for 1974-75 and geographic detail as well as totals for 1976-77. In the case of the mining, smelting, and refining industry, there was but a negligible increase in investment between 1976 and 1977, and in the petroleum industry, there was an 8.7% growth. Development patterns by geographic areas varied significantly, and can best be appraised by detailed review of table 6.

TRANSPORTATION

MARINE TRANSPORT

Tankers, bulk carriers, and freighters are the three classes of vessels engaged in transporting mineral commodities. The number, gross tonnage, and deadweight tonnage of these vessels, as reported by the U.S. Maritime Administration for 1973-77, are given in table 7. Although there is a modest difference in reporting categories between 1973-1974 and 1975-77, this difference (inclusion of refrigerated vessels among freighters rather than among other vessels) in the latter period is of little overall significance. It should be noted that vessels in each of the three categories are not wholly devoted to mineral commodity transport. Tankers, although largely engaged in moving crude oil and refinery products, also transport some liquid chemicals, wine, molasses, and whale oil. Bulk carriers move agricultural products as well as crude minerals and mineral fertilizers, while freighters, because of their great variety, can be wholly devoted to hauling mineral products or wholly to moving nonmineral goods, as well as carrying mixed mineral and nonmineral cargos.

Table 8 gives information on total loadings and unloadings of vessels, divided between tanker-type cargo and dry cargo, for the years 1973-77. The foregoing text on trade discussed the disparity in growth rates between the value of mineral commodities moved and total quantity of goods loaded during the years covered by this table. While it is recognized that these figures on loadings and unloadings include goods other than minerals, these nevertheless serve as a reasonable measure of mineral commodity shipments, because of the preponderance of total weight of all goods moved is accounted for by minerals. Some measure of the significance of mineral commodity movement to total commodity movement is apparent in data for the world's two major canals, the Panama and the Suez, and it should be noted that figures for these waterways are skewed in favor of nonmineral commodities by both waterways' inability to handle the huge supertankers and bulk cargo vessels engaged in ore trade. Although exact recent figures are not available, it appears likely that minerals and mineral products account for three quarters or more of total cargo carried in any one year on a weight basis.

A geographic breakdown of loadings and unloadings of dry cargo and tanker cargo are given in tables 9 and 10, respectively, for 1975-77, on a tonnage basis. Again recognizing that both tables include mineral and nonmineral goods, but also recognizing the dominance of mineral materials from the viewpoint of tonnage, these tables give some idea of the relative importance of various world areas as origins and destinations for mineral materials.

Bulk Carriers.—In 1977, the world's bulk carrier fleet increased by 362 vessels, compared with an increase of 298 vessels in 1976. This represented a 7.9% growth in 1977 on the basis of the number of vessels, which can be compared with an 8.7% increase in gross tonnage and a 9.4% increase in deadweight tonnage, demonstrating the continued gradual shift toward larger vessels. In 1977, the average bulk carrier grossed 21,034 tons and had a deadweight tonnage of 36,219, compared with 1976 figures of 20,886 and 35,733 tons, respectively. The following tabulation shows the distribution of the world bulk carrier fleet by country of registry in 1977:

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Country	Number of vessels	Deadweight tonnage (thousand tons)
Liberia	1,037	44,102
Japan	590	23,688
Greece	691	18,485
Norway	320	17,990
United Kingdom	322	14,643
Italy	158	7,448
Panama	325	7,314
India	103	4,308
Sweden	76	4,269
Germany, Federal Republic of	72	3,920
France	55	2,690
Singapore	67	2,397
U.S.S.R.	178	2,315
Spain	64	2,017
Brazil	42	1,945
Poland	76	1,881
Other	756	19,221
Total	4,932	178,633

Freighters.—In 1977, the world's freighter fleet declined by 747 vessels, but increased in terms of gross tonnage (4.4%) and deadweight tonnage (5%), another reflection of the increase in vessel size aimed at more economical operations. The average freighter in 1977 had a gross weight of 6,686 tons (6,032 tons in 1976) and a deadweight tonnage of 9,022 tons (8,097 tons in 1976), substantial increases when the number of vessels involved is considered. The following tabulation shows the distribution of the world's freighter fleet by country of registry in 1977:

Country	Number of vessels	Deadweight tonnage (thousand tons)
Greece	1,263	11,959
U.S.S.R.	1,727	10,805
Panama	1,414	10,598
United Kingdom	667	6,905
United States	484	6,890
Japan	747	6,431
Liberia	593	6,109
Germany, Federal Republic of	433	3,960
China, People's Republic of	320	3,339
Singapore	373	3,086
Cyprus	422	2,668
Norway	285	2,469
India	214	2,462
Netherlands	330	2,368
Other	3,904	29,808
Total	13,176	109,857

It is noteworthy that Greece displaced the U.S.S.R. as the first-ranked nation in terms of deadweight tonnage.

Tankers.—In 1977, the world's tanker fleet was 50 vessels smaller than in 1976, a decrease of nearly 1%, but the gross tonnage for vessels of this class advanced by 3.5% and the deadweight tonnage by 4.3%. The growth rates for tonnages for tankers were lower than the corresponding figures for bulk carriers and freighters, reflecting the reduced growth rates in world petroleum movement and supply. Nevertheless, the upward trend in the average size of tankers continued, with the average tanker in 1977 grossing 34,766 tons (33,274 tons in 1976) and having a deadweight tonnage of 65,625 tons (62,344 tons in 1976). The following tabulation distributes the world's tanker fleet by country of registry in 1977:

Country	Number of vessels	Deadweight tonnage (thousand tons)
Liberia	982	107,454
Japan	488	32,279
Norway	341	32,033
United Kingdom	375	29,476
Greece	366	19,124
France	144	15,941
Panama	259	13,086
United States	276	12,149
Italy	232	8,959
Spain	130	8,926
U.S.S.R.	465	7,143
Germany, Federal Republic of	80	6,748
Sweden	79	6,485
Singapore	110	6,294
Denmark	73	5,480
Netherlands	72	4,297
Other	861	34,102
Total	5,333	349,976

OCEAN FREIGHT RATES

In general, ocean freight rates turned downward in 1977 from the levels of 1976, according to data published by the United Nations. Rates advanced over 1976 only in the cases of the smallest size groups of vessels, and these upturns were noted both for tanker cargos and dry cargos. For statistical details, the reader is referred to the United Nations Monthly Bulletin of Statistics; indexes of ocean freight rates are published quarterly in March, June, September, and December.

PANAMA AND SUEZ CANALS

The Panama Canal reported a decline in the number of vessel transits but an increase in the quantity of cargo moved through the canal in the fiscal year October 1, 1976, through September 30, 1977, in comparison to the fiscal year July 1, 1975, to June 30, 1976. In fiscal year 1977, mineral commodities constituted about 48% of total cargo moved. The following tabulation summarizes Panama Canal activities for the fiscal years 1975-77, with a separate column for the transition quarter (July-September

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1976) that resulted from the change in the U.S. Government's fiscal year:

	Fiscal year[1]		Transition quarter[2]	1977
	1975	1976		
Number of transits:				
Commercial ocean traffic	13,609	12,157	3,037	11,896
Other traffic	1,126	1,044	276	1,191
Total	14,735	13,201	3,313	13,087
Cargo moved (thousand metric tons):				
Commercial ocean traffic:				
Mineral commodities	89,250	65,861	15,008	60,078
Other commodities	53,100	53,233	16,376	64,875
Subtotal	142,350	119,094	31,384	124,953
Other traffic	543	193	58	219
Total	142,893	119,287	31,442	125,172

[1]Data for 1975 and 1976 are for years ending June 30 of that stated; data for 1977 are for year ending September 30, 1977.
[2]July 1, 1976-September 30, 1976.

Among major groups of mineral commodities, coal and coke accounted for 21.9% of total mineral commodities in fiscal 1977, followed by crude oil (21.3%), petroleum refinery products (17.1%), metallic ores (16.9%), and fertilizer materials (11.2%). For further details on Panama Canal operations, the reader is referred to the Panama Canal Company Annual Report series.

The Suez Canal recorded an increase in both number of vessel transits and in cargo moved in 1977 with respect to 1976 levels, but the quantity of mineral commodities moved fell sharply, as shown in the following tabulation summarizing operations:

	1975[1]	1976	1977
Number of transits:			
Commercial ocean traffic	5,495	16,402	NA
Other traffic	84	404	NA
Total	5,579	16,806	14,703
Cargo moved, commercial ocean traffic (thousand metric tons):			
Mineral commodities	16,684	105,203	68,806
Other commodities	20,936	12,450	59,887
Total	r37,620	r117,653	128,693

rRevised. NA Not available.
[1]June 5 through December 31.

Major components of total mineral commodity trade were crude oil (35.7%), petroleum refinery products (15.7%), fertilizer materials (10.7%), and cement (8.8%).

It is significant to note that since its reopening, the Suez Canal has been transiting a growing number of the smaller so-called supertankers—200,000 tons and over. These vessels can successfully utilize the canal only in their unladen (generally southbound) trips from the refining centers of Europe and Eastern North America back to the Persian Gulf ports, but even this one-way use of the canal reduces sailing time and distance compared to the journey around the Cape of Good Hope, thereby reducing operating expenses significantly. The largest vessel to transit the canal in 1977 was about 250,000 tons; larger craft cannot use it even sailing in ballast (unladen). Development activities were under way in 1977 aimed at a goal of permitting vessels of up to 150,000 deadweight tons to transit the canal fully laden by June 30,

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1980.

PIPELINES

An overall appraisal of worldwide progress on pipelines is impossible owing to limitations of space and time; however, in general terms, construction activity continued at a substantial level. The Trans-Alaskan pipeline linking Alaska's north slope oilfields to the Port of Valdez operated at a rate of over 1 million barrels per day. Gaslines were completed linking Norway's North Sea fields to the main European continent, and shipments began.

PRICES

Comprehensive data on world prices for crude minerals and mineral products are not available, but tables 11, 12, and 13 reflect the mixed pattern in nonferrous metal prices in the United States, the United Kingdom, and Canada, respectively, during each month of 1977. Individual monthly patterns are not consistent between the various markets and defy clear verbalization, but it is evident in comparing annual average figures that aluminum, lead, and tin prices increased in both 1976 and in 1977 over previous levels in each market area; that copper, after increasing between 1975 and 1976, declined in 1977; that silver, after a decline between 1975 and 1976, registered a notable increase in 1977; and that zinc continued downward in 1977 after a decline in 1976 in both the U.S. and United Kingdom markets and a very small 1975-76 increase on the Canadian market.

Regretably, the United Nations statistical series on export price indexes for mineral commodities which appeared in tables 32 and 33 of the 1976 edition of this chapter has been discontinued, and the tables are therefore omitted since nc more recent data are available than those published in the previous edition.

Little need be said about continued advances in fuel prices. Though growth rates varied around the world, the trend was almost without exception upward, with oil leading the way and gas and coal following along, in an upward direction. The requirements of other sectors of the mineral industry for fuels to process crude mine products into ores, made price increases for a number of mineral commodities inevitable and affected industry profitability for commodities that were in oversupply, where fuel prices could not be successfully passed on to nonfuel mineral purchasers.

STATISTICAL SUMMARY OF WORLD PRODUCTION AND TRADE OF MAJOR MINERAL COMMODITIES

The final 24 tables of this chapter (tables 14 through 37) extend the statistical series on production that was started in the 1963 edition of the International Area Reports volume of the Minerals Yearbook and was subsequently updated and expanded in the 1965 and 1967-76 editions. They are primarily a supplement to other statistical data within this chapter but also serve as a summary of international production and trade data for major mineral commodities covered in greater detail on a commodity basis in Volume I of the 1976 Minerals Yearbook and on a country basis in the balance of Volume III.

The data presented in these tables in most instances correspond directly to the data in the individual commodity world production tables appearing in Volume I and as such may not correspond exactly to figures presented in the individual country chapters of Volume III. Such differences are usually the result of the receipt of revised data for inclusion in either a commodity chapter or a country chapter subsequent to the completion of the other chapter. In most cases, country chapters were prepared later than commodity chapters and should be regarded as more reliable. In this 1977 edition, one additional commodity, chromite, has been added to the roster of commodities covered, this because of the relatively large volume of this mineral that is mined and shipped annually, and because of considerable international interest in the commodity.

Data presented in previous editions of this chapter, summarizing world trade in major mineral commodities (see tables 57-69 in the 1976 edition), could not be included in this edition because of other Bureau projects and alterations in the schedule for preparing the Minerals Yearbook.

[1]Supervisory physical scientist, Geographic Statistics Staff, Branch of Foreign Data.

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Table 1.—World production of major mineral commodities[1]

Commodity	1975	1976	1977[p]
METALS			
Aluminum:			
Bauxite, gross weight[2] thousand metric tons	[r]76,895	79,989	84,568
Alumina, gross weight do	[r]26,186	26,771	29,486
Unalloyed ingot metal do	[r]12,140	12,496	13,660
Antimony, mine output, metal content metric tons	[r]70,135	69,614	69,535
Arsenic, white[3 4] do	[r]40,496	34,910	34,315
Beryl concentrate, gross weight[3 4] do	[r]2,985	2,422	2,416
Bismuth[3] do	[r]3,971	3,870	4,005
Cadmium, smelter output do	[r]15,250	16,483	17,125
Chromite, gross weight[4] thousand metric tons	[r]8,296	8,630	9,800
Cobalt:			
Mine output, metal content metric tons	[r]30,827	28,300	29,554
Refined do	[r]20,785	18,456	19,371
Columbium-tantalum concentrates[4 5] do	[r]19,994	23,565	26,708
Copper:			
Mine output, metal content thousand metric tons	[r]7,009	7,502	7,711
Smelter, primary[6] do	[r]6,973	7,289	7,506
Smelter, secondary[7] do	1,090	1,174	1,201
Refinery, primary[6] do	[r]6,925	7,357	7,636
Refinery, secondary[7] do	347	432	506
Gold, mine output, metal content thousand troy ounces	[r]38,476	39,642	39,385
Iron and steel:			
Iron ore, gross weight thousand metric tons	[r]902,018	900,347	857,128
Pig iron do	[r]479,726	500,122	492,261
Ferroalloys do	[r]12,630	12,758	12,232
Crude steel do	[r]643,798	677,362	673,694
Lead:			
Mine output, metal content do	[r]3,434	3,339	3,414
Smelter, primary[6] do	[r]3,294	3,455	3,489
Smelter, secondary[7] do	1,245	1,353	1,501
Magnesium, primary smelter[8] metric tons	125,577	135,129	137,132
Manganese ore, gross weight thousand metric tons	[r]24,656	24,598	22,019
Mercury, mine output, metal content do	[r]8,706	8,277	6,866
Molybdenum, mine output, metal content do	[r]83,173	88,616	95,047
Nickel:			
Mine output, metal content do	[r]807,513	821,014	796,298
Smelter do	[r]752,848	782,739	745,236
Platinum-group metals, mine output thousand troy ounces	5,714	5,979	6,386
Selenium, smelter[4 5] metric tons	[r]1,182	1,135	1,154
Silver, mine output, metal content thousand troy ounces	[r]303,112	312,150	325,475
Tellurium, smelter[4 5] metric tons	[r]155	[s]90	[s]138
Tin:			
Mine output, metal content do	[r]222,283	228,005	230,333
Smelter do	[r]227,895	229,861	230,243
Titanium concentrates, gross weight:			
Ilmenite[4 9] thousand metric tons	[r]3,651	4,023	4,094
Rutile[3 4] do	[r]382	428	359
Tungsten, mine output, metal content metric tons	[r]38,306	41,661	42,492
Uranium oxide, mine output, U_3O_8 content[4 5] do	24,198	28,234	34,616
Vanadium, mine output, metal content do	[r]25,845	28,389	30,162
Zinc:			
Mine output, metal content thousand metric tons	[r]5,852	5,771	6,048
Smelter, primary[6] do	[r]5,014	5,362	5,481
Smelter, secondary[7] do	215	267	244
Zirconium concentrate[3 4 5] do	418	446	424
NONMETALS			
Asbestos do	[r]4,145	5,109	5,335
Barite do	[r]4,923	5,137	5,347
Bromine[4] do	277	305	296
Cement, hydraulic do	[r]702,138	735,391	777,385
Clays:			
Bentonite[4 5] do	4,818	5,058	5,445
Fuller's earth[4 5] do	1,426	1,508	1,592
Kaolin[4] do	[r]15,023	16,571	16,980

See footnotes at end of table.

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Table 1.—World production of major mineral commodities[1] —Continued

Commodity	1975	1976	1977[p]
NONMETALS —Continued			
Diamond:			
Gem[4] thousand carats	[r]10,264	9,444	10,381
Industrial[4] do.	[r]30,600	28,629	29,089
Total[4] do.	[r]40,864	38,073	39,470
Diatomite[4] thousand metric tons	[r]1,675	1,745	1,803
Feldspar[4] do.	[r]2,622	2,658	2,756
Fluorspar do.	[r]4,525	4,472	4,680
Graphite[3] metric tons	[r]448,614	449,226	454,240
Gypsum thousand metric tons	[r]59,239	62,747	65,511
Lime[4] do.	[r]105,250	108,392	110,354
Magnesite[3] do.	[r]9,638	8,942	8,854
Mica[4] do.	[r]222	212	266
Nitrogen fertilizers, contained nitrogen[10] do.	[r]42,440	43,809	45,863
Phosphate rock and guano do.	[r]107,678	107,640	115,972
Potash, marketable, K_2O equivalent do.	[r]24,740	24,259	25,772
Pumice[4 5] do.	[r]14,723	15,779	15,489
Salt do.	[r]161,662	168,165	169,956
Sodium compounds:			
Sodium carbonate[4] do.	[r]19,343	19,630	19,681
Sodium sulfate[4] do.	[r]2,470	2,522	2,530
Strontium minerals[4 5] metric tons	52,659	61,457	67,262
Sulfur, elemental basis:			
Elemental[11] thousand metric tons	[r]17,246	16,889	16,211
From pyrite do.	[r]9,522	9,461	9,224
Byproduct[12] do.	[r]23,418	24,141	25,973
Total do.	[r]50,186	50,491	51,408
Talc, soapstone, pyrophyllite do.	[r]4,872	5,398	5,742
Vermiculite[4 5] metric tons	[r]533,314	523,949	517,391
MINERAL FUELS AND RELATED MATERIALS			
Carbon black[4 5] thousand metric tons	[r]3,187	3,539	3,645
Coal:			
Anthracite million metric tons	[r]179	180	191
Bituminous do.	2,244	2,306	2,346
Lignite do.	857	884	896
Total do.	[r]3,280	3,370	3,433
Coke:			
Metallurgical[13] thousand metric tons	[r]363,993	367,316	355,589
Other[13] do.	[r]18,504	18,011	18,279
Gas, natural, marketed billion cubic feet	47,364	49,497	51,394
Natural gas liquids[4] million barrels	[r]1,037	1,059	1,086
Peat thousand metric tons	[r]203,338	202,427	203,158
Petroleum:			
Crude million 42-gallon barrels	19,502	21,192	21,901
Refined do.	19,674	21,270	22,387

[p]Preliminary. [r]Revised.

[1]Incorporates numerous revisions from world production tables and country production tables appearing in Volumes I and III, respectively, of the Minerals Yearbook, as well as from the table corresponding to this table in previous editions of this chapter.

[2]Includes bauxite equivalent of nepheline syenite and alunite produced in the U.S.S.R. (the only producer of record of such materials as a source of aluminum).

[3]Excludes data for the United States (withheld to avoid disclosing company proprietary data).

[4]Excludes data for the People's Republic of China (no adequate basis for estimation available).

[5]Excludes data for the U.S.S.R. (no adequate bases for estimation available).

[6]Includes all metal clearly identified as primary as well as all metal that cannot be subdivided clearly between primary and secondary (see footnote 7).

[7]Includes only that metal that is clearly identified as secondary. Some countries do not distinguish between primary and secondary and for some of these, no basis is available for estimating the breakdown of total production. For such countries, the total has been included under primary above (see footnote 6).

[8]Excludes data for the United States (withheld to avoid disclosing company proprietary data), which in previous years accounted for approximately 50% of the world total.

[9]Includes leucoxene and titaniferous slag.

[10]Data are for years ending June 30 of that stated.

[11]Comprises sulfur produced by the Frasch process plus sulfur mined in the elemental state from ores.

[12]Comprises sulfur recovered from coal gasification, metallurgical operations (except pyrite processing), natural gas, petroleum, tar sands, spent oxides, and gypsum, whether recovered in the elemental state or as a sulfur compound.

[13]Production of coke other than metallurgical by the People's Republic of China and the U.S.S.R. included with metallurgical coke production.

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Table 2.—Value of world export trade in major mineral commodities[1]

(Million U.S. dollars)

Commodity group	1972	1973	1974	1975	1976	1977
Metals:						
All ores, concentrates, scrap	7,749	10,957	15,608	14,867	15,743	16,010
Iron and steel	20,103	28,464	46,424	45,783	44,661	46,825
Nonferrous metals	11,902	17,301	24,814	18,304	21,423	24,012
Subtotal	39,754	56,722	86,846	78,954	81,827	86,847
Nonmetals, crude only	3,035	3,842	5,758	6,167	6,391	6,962
Mineral fuels	41,775	63,153	172,178	169,281	199,273	221,137
Total	84,564	123,717	264,782	254,402	287,491	314,946
All commodities	413,382	573,788	837,394	872,574	988,947	1,123,624

[1]Data presented are for selected major commodity groups of the Standard International Trade Classification Revised (SITC-R) and as such exclude some mineral commodities classified in that data array together with other (nonmineral) commodities. SITC-R categories included are as follows: All ores, concentrates, and scrap-SITC Division 28; iron and steel-SITC Division 67; nonferrous metals-SITC Division 68; nonmetals (crude only)-SITC Division 27; mineral fuels-SITC Division 3. Major items not included are the metals, metalloids, and metal oxides of SITC Group 513; mineral tar and other coal-, petroleum-, and natural gas-derived crude chemicals of SITC Division 52; manufactured fertilizers of SITC Division 56; and nonmetallic mineral manufactures of SITC Groups 661, 662, 663, 667. Data include special category exports, ships' stores and bunkers and other exports of minor importance, and excludes the intertrade of the centrally planned economy countries of Asia and trade between Federal Republic of Germany and German Democratic Republic.

Source: United Nations. Monthly Bulletin of Statistics, New York, v. 32, No. 6, June 1978, pp. xxxii-lvi and v. 33, No. 5, May 1979, pp. xxxii-lvi.

Table 3.—Distribution of value of world export trade in major mineral commodity groups, by commodity group[1]

(Percent)

Commodity group	1972	1973	1974	1975	1976	1977
Metals:						
All ores, concentrates, scrap	9.1	8.9	r5.9	5.8	5.5	5.1
Iron and steel	r23.8	r23.0	r17.5	r18.0	15.5	14.9
Nonferrous metals	r14.1	r14.0	r9.4	7.2	7.5	7.6
Subtotal	r47.0	r45.9	r32.8	r31.0	28.5	27.6
Nonmetals, crude only	r3.6	3.1	2.2	2.4	2.2	2.2
Mineral fuels	r49.4	r51.0	r65.0	r66.6	69.3	70.2

rRevised.
[1]For detailed definition of groups, see footnote 1, table 2.

Table 4.—Growth of value of world export trade in major mineral commodity groups[1]

(Percent change from previous year)

Commodity group	1972	1973	1974	1975	1976	1977
Metals:						
All ores, concentrates, scrap	r+7.2	r+41.4	+42.4	-4.7	+5.9	+1.7
Iron and steel	+13.5	+41.6	r+63.1	-1.4	-2.5	+1.0
Nonferrous metals	r+13.5	r+45.4	r+43.4	-26.2	+17.0	+12.1
All metals	r+12.2	r+42.7	r+53.1	-9.1	+3.6	+6.1
Nonmetals, crude only	r+10.6	r+26.6	r+49.9	+7.1	+3.6	+8.9
Mineral fuels	r+15.5	r+51.2	r+172.6	-1.7	+17.7	+11.0
All major mineral commodity groups	r+13.8	r+46.3	r+114.0	-3.9	+13.0	+9.5
All commodities	r+19.4	r+38.8	r+45.9	+4.2	+13.3	+13.6

rRevised.
[1]For detailed definition of groups, see footnote 1, table 2.

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Table 5.—Annual investment expenditure in the steel industry for selected countries

(Million dollars unless otherwise specified)

Country or country group	1975	1976	1977
EEC	3,302	[1]3,293	[1]2,378
EFTA[2]	475	816	544
Other countries:			
Australia	131	164	140
Canada	238	392	391
Japan	2,033	3,443	3,824
Spain	239	420	476
Turkey	180	271	295
United States	1,400	3,255	2,965
Total	7,998	[3]12,054	[3]11,013

[1]Source reports values for EEC countries are in terms of "million units of account." For the Federal Republic of Germany (included in EEC in this tabulation), the source indicates that for 1976, 823.1 million "units of account" was equivalent to $885.3 million (no conversion rate given for other countries for 1976 and no conversion rate given for any country for 1977, and no further explanation is offered).

[2]Figures exclude data for Switzerland.

[3]Figures have been totaled as if EEC data were U.S. dollars, in keeping within totals appearing in a graph in source publication (see footnote 1).

Source: Organization for Economic Cooperation and Development. The Iron and Steel Industry in 1977. Paris 1979, p. 26.

Table 6.—U.S. direct foreign investment in mineral industries: Value, earnings, and income

(Million dollars)

Area and country	Mining, smelting, refining			Petroleum		
	Value	Earnings[1]	Income[2]	Value	Earnings[1]	Income[2]
1974	5,790	868	680	30,195	13,433	11,714
1975	6,548	686	448	26,200	4,795	2,738
1976:						
Canada	3,200	253	126	r7,181	r1,006	r282
Latin America and other Western Hemisphere:						
Latin American Republics:						
Chile	5	-2	(3)	W	W	4
Peru	W	W	W	W	1	2
Venezuela	-21	W	W	r229	47	46
Other[4]	1,179	116	72	r1,426	175	57
Subtotal	1,163	114	72	r1,655	223	109
Other Western Hemisphere	437	84	84	r1,277	225	113
Total[5]	r1,601	198	156	r2,932	448	222
Europe:						
EEC:						
Denmark and Ireland	2	-1	(3)	513	r-22	r-23
United Kingdom	11	-1	(3)	r4,592	r-38	r-14
Other[4 6]	r-1	-1	(3)	r5,332	r423	r377
Subtotal	12	-3	(3)	r10,437	r363	r340
Other Western Europe	22	-2	(3)	r2,289	r217	r207
Total	34	-5	(3)	r12,726	580	r547
Africa:						
Republic of South Africa	W	23	6	W	42	W
Other	534	W	W	r1,596	r467	r390
Total[7]	534	23	6	1,596	r509	r390
Near East	8	2	(3)	r-4,812	r1,659	r1,596
Far East and Pacific:						
Japan	--	--	--	r1,567	113	10
Australia	r1,238	350	225	r899	185	155
New Zealand	W	(3)	(3)	W	r5	W

See footnotes at end of table.

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Table 6.—U.S. direct foreign investment in mineral industries: Value, earnings, and income —Continued

(Million dollars)

Area and country	Mining, smelting, refining			Petroleum		
	Value	Earnings[1]	Income[2]	Value	Earnings[1]	Income[2]
1976 —Continued						
Far East and Pacific —Continued						
Other	167	W	r(3)	r2,544	r396	r1,132
Total	r1,405	350	225	r5,010	r699	r1,297
International and unallocated, including shipping	278	108	78	r3,775	222	51
Grand total[5]	r7,060	929	591	r18,408	r5,123	r4,385
1977:						
Canada	3,212	231	160	7,722	992	355
Latin America and other Western Hemisphere:						
Latin American Republics:						
Chile	W	-5	-1	W	9	3
Peru	807	W	W	328	31	31
Venezuela	W	W	W	223	61	59
Other[4]	391	119	91	1,217	268	135
Subtotal	1,198	114	90	1,768	369	228
Other Western Hemisphere	382	105	105	1,611	220	105
Total[5]	1,579	218	194	3,378	589	333
Europe:						
EEC:						
Denmark and Ireland	1	-1	(3)	514	-17	-15
United Kingdom	W	-1	-2	5,311	325	223
Other[4 6]	18	(3)	(3)	5,442	274	501
Subtotal	19	-2	-2	11,267	582	709
Other Western Europe	21	-1	(3)	2,659	239	185
Total[5]	40	-3	-2	13,926	822	895
Africa:						
Republic of South Africa	W	15	3	W	W	W
Other	544	W	41	1,520	461	412
Total[7]	544	15	44	1,520	461	412
Near East	9	W	W	-4,378	1,607	1,549
Far East and Pacific:						
Japan	--	--	--	1,549	76	64
Australia	1,255	306	229	948	128	93
New Zealand	W	1	1	W	W	W
Other	132	-2	W	2,493	706	577
Total	1,387	305	230	4,990	910	734
International and unallocated, including shipping	295	47	6	3,729	100	200
Grand total[5]	7,066	813	632	30,887	5,481	4,478

rRevised. W Withheld (in source publication) to avoid disclosing data of individual companies.
[1]Sum of U.S. share in net earnings of subsidiary and branch profits.
[2]Sum of interest, dividends, and earnings of unincorporated affiliates.
[3]Less than 1/2 unit.
[4]Calculated, by difference between listed detail and reported total.
[5]Detail may not add to totals shown because of independent rounding and exclusion of some data in detail.
[6]Includes Belgium, France, Federal Republic of Germany, Italy, Luxemborg, and the Netherlands.
[7]Not reported in source, sum of reported detail, and incomplete in some cases, owing to withheld data in detail.

Source: U.S. Department of Commerce. Survey of Current Business, v. 58, No. 8, August 1978, pp. 27-36.

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Table 7.—World merchant fleet distribution, by type[1]

	1973	1974	1975	1976	1977
Number of vessels:					
Tankers	4,813	5,121	5,311	5,383	5,333
Bulk carriers	3,800	4,075	4,272	4,570	4,932
Freighters	11,170	11,449	[2]12,575	[2]12,923	12,176
Other	1,817	1,804	[3]714	[3]710	655
Total	21,600	22,449	22,872	23,586	23,096
Gross tonnage:					
Tankers thousand tons	122,370	143,399	163,731	179,116	185,405
Bulk carriers do	74,660	82,313	88,194	95,451	103,741
Freighters do	66,790	68,855	[2]75,284	[2]77,939	[2]81,414
Other do	11,907	11,799	[3]5,833	[3]5,697	[3]5,268
Total do	275,727	306,366	333,042	358,203	375,828
Deadweight tonnage:					
Tankers do	220,481	261,440	302,217	335,600	349,976
Bulk carriers do	126,140	139,267	150,080	163,298	178,633
Freighters do	90,511	93,476	[2]101,248	[2]104,639	[2]109,857
Other do	9,238	9,165	[3]3,027	[3]2,962	[3]2,753
Total do	446,370	503,348	556,572	606,499	641,219

[1]Maritime Administration classification. Tankers include whaling tankers. Vessels shown here as "Other" include combination passenger and cargo, combination passenger and refrigerated cargo, and refrigerated freighters, except as otherwise indicated. Contribution of these vessels to mineral commodity trade is regarded as unimportant. Data are as of December 31 of year indicated.
[2]Figures include refrigerated freighters.
[3]Figures exclude refrigerated freighters.

Source: U.S. Department of Commerce, Maritime Administration. Merchant Fleets of the World. Annual issues covering 1973 through 1977.

Table 8.—World shipping loadings and unloadings[1]

(Million metric tons)

	1973	1974	1975	1976[r]	1977
Loadings:					
Tanker cargo	1,873	1,837	1,644	1,803	1,818
Dry cargo	1,403	1,476	1,428	1,588	1,657
Total	3,276	3,313	3,072	3,391	3,475
Unloadings:					
Tanker cargo	1,862	1,784	1,660	1,814	1,881
Dry cargo	1,376	1,477	1,396	1,469	1,490
Total	3,238	3,261	3,056	3,283	3,371

[r]Revised.
[1]Data presented are as reported in source, and as such may not be the arithmetic total of figures presented in tables 9 and 10.

Source: United Nations. Monthly Bulletin of Statistics, New York, v. 33, No. 1, January 1979, p. xxxv.

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Table 9.—World shipping of dry cargo by geographical area

(Million metric tons)

Area	Loadings			Unloadings		
	1975	1976	1977	1975	1976	1977
Market economy countries:						
Developed:						
Australia and New Zealand	170	r163	174	24	r19	20
Canada	96	111	116	43	38	41
Japan	69	r76	79	302	r335	350
South Africa, Republic of	21	r26	30	11	r7	8
United States	244	r252	245	137	r114	136
Western Europe	288	r323	337	505	r579	554
Other	3	4	3	3	r--	28
Total	891	r955	984	1,025	r1,092	1,137
Developing:						
Caribbean	27	r24	24	15	r12	22
Far East	108	r144	153	104	r110	135
Near East	14	r46	49	43	r44	46
Northern Africa	25	r34	36	33	r30	31
Other Africa	83	r81	94	26	r25	26
Venezuela	21	r22	22	7	r7	7
Other Latin America	148	r149	149	50	r51	52
Other	8	10	10	2	r4	4
Total	434	r510	537	280	r283	323
Centrally planned economy countries:						
U.S.S.R	47	r66	72	29	r25	26
Other	56	r57	64	62	r69	60
Total	103	r123	136	91	r94	86

rRevised.

Source: United Nations. Monthly Bulletin of Statistics, New York, v. 33, No. 1, January 1979, pp. xxxv-xxxviii.

Table 10.—World shipping of tanker cargo by geographical area

(Million metric tons)

Area	Loadings			Unloadings		
	1975	1976	1977	1975	1976	1977
Market economy countries:						
Developed:						
Australia and New Zealand	3	3	1	15	16	16
Canada	6	4	4	21	18	18
Japan	1	--	--	247	241	232
South Africa, Republic of	--	--	--	16	17	17
United States	2	6	6	279	374	432
Western Europe	105	115	120	727	736	720
Other	26	21	21	28	28	56
Total	143	149	152	1,333	1,430	1,491
Developing:						
Caribbean	48	56	55	91	101	105
Far East	88	93	110	99	117	115
Near East	921	1,023	1,018	15	24	23
Northern Africa	124	145	146	9	16	17
Other Africa	106	119	114	16	15	14
Venezuela	110	109	108	--	--	--
Other Latin America	19	19	23	62	68	73
Other	--	--	--	4	3	4
Total	1,416	1,564	1,574	296	344	351
Centrally planned economy countries:						
U.S.S.R	73	78	82	6	8	7
Other	3	4	2	23	30	29
Total	76	82	84	29	38	36

Source: United Nations. Monthly Bulletin of Statistics, New York, v. 33, No. 1, January 1979, pp. xxxv-xxxviii.

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Table 11.—Nonferrous metal prices in the United States

(Average, cents per pound, unless otherwise specified)

Year and month	Aluminum[1]	Copper[2]	Lead[3]	Zinc[4]	Tin[5]	Silver[6]
1975	39.786	63.535	21.529	38.959	339.818	441.852
1976	44.341	68.824	28.102	37.010	349.241	435.346
1977:						
January	48.000	65.340	26.865	37.000	427.810	440.900
February	48.000	67.725	28.692	37.000	466.987	453.505
March	49.174	71.651	31.000	37.000	478.674	484.161
April	51.000	73.493	31.000	37.000	443.762	477.705
May	51.000	71.630	31.000	35.500	443.691	469.195
June	51.000	70.199	31.000	34.000	447.559	444.300
July	52.895	66.996	31.000	34.000	482.105	449.805
August	53.000	62.792	31.000	34.000	518.261	444.435
September	53.000	59.625	31.000	34.000	529.048	453.862
October	53.000	59.625	31.023	31.897	588.300	476.315
November	53.000	59.635	32.000	30.730	589.158	482.840
December	53.000	60.942	32.854	30.500	573.119	470.595
Average	51.339	65.804	30.703	34.386	499.381	462.303

[1]Unalloyed ingot, 99.5%, delivered United States.
[2]Electrolytic copper, domestic refineries, on Atlantic seaboard.
[3]Refined lead, nationwide.
[4]Prime Western slab, f.o.b. East St. Louis.
[5]Straits tin, New York.
[6]Cents per troy ounce, 999 fine, New York.

Table 12.—Nonferrous metal prices in the United Kingdom

(Average, U.S. cents per pound, unless otherwise specified)[1]

Year and month	Aluminum[2]	Copper[3]	Lead[4]	Zinc	Tin[5]	Silver[6]
1975	39.460	56.110	18.681	33.792	311.627	441.746
1976	40.400	64.051	20.502	32.804	349.128	434.922
1977:						
January	46.990	63.279	25.313	31.320	430.080	439.955
February	48.870	64.677	29.323	31.861	464.188	453.508
March	49.080	68.652	31.868	32.556	470.720	485.823
April	49.120	64.775	29.398	29.658	434.977	479.207
May	49.110	62.217	29.934	27.716	446.210	470.002
June	51.080	59.526	25.704	24.546	437.249	446.688
July	53.130	56.624	25.427	24.529	472.946	453.035
August	53.660	52.566	24.950	23.543	518.355	446.910
September	53.760	54.230	26.389	23.435	510.460	453.483
October	54.630	54.883	27.878	23.200	559.979	476.224
November	56.070	53.638	28.707	23.792	582.689	482.482
December	57.200	57.152	31.059	24.353	581.587	472.404
Average	51.890	59.380	28.002	26.733	489.539	463.310

[1]London Metal Exchange, average settlement prices.
[2]Ingot, 99.5%.
[3]Electrolytic wirebar.
[4]Refined pig lead, 99.97%.
[5]Standard tin.
[6]U.S. cents per troy ounce, 999 fine.

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Table 13.—Nonferrous metal prices in Canada

(Average, U.S. cents per pound, unless otherwise specified)

Year and month	Copper[1]	Lead[2]	Zinc[2]	Silver[3]
1975	62.761	19.945	36.378	440.931
1976	69.578	22.945	37.368	435.703
1977:				
January	66.811	26.231	35.882	441.933
February	68.107	27.680	35.269	434.719
March	67.615	29.075	34.483	484.621
April	74.537	29.482	34.475	478.049
May	73.941	29.790	34.229	470.078
June	71.030	30.492	33.565	444.741
July	67.978	30.389	33.452	450.802
August	63.420	30.002	33.025	444.953
September	60.676	30.047	33.075	454.350
October	59.270	29.351	29.578	476.870
November	58.707	30.219	29.297	482.689
December	59.901	31.668	29.618	470.761
Average	65.999	29.536	32.996	461.214

[1]Electrolytic wirebar, f.o.b. delivered Canadian points.
[2]Pig lead, Prime Western zinc; producer's prices, carload quantities, communicated by Cominco, Ltd.
[3]U.S. cents per troy ounce, average price of Cominco, Ltd.

Table 14.—Leading world producers of bauxite

(Gross weight, thousand metric tons)

Country	1975	1976	1977[p]
Australia	[r]21,003	24,084	26,070
Jamaica	11,571	10,311	11,433
Guinea[e]	[r]8,406	11,316	11,320
U.S.S.R.[e 1]	6,470	6,620	6,780
Surinam	4,928	4,613	4,924
Greece	[r]3,006	2,551	2,984
Hungary	2,890	2,918	2,948
Guyana	3,250	2,686	2,731
Yugoslavia	2,306	2,033	2,044
France	2,563	2,330	2,028
United States	1,801	1,990	2,013
India	1,273	1,448	1,511
Total	69,467	72,900	76,786
All others	7,427	7,089	7,783
Grand total	76,894	79,989	84,569

[e]Estimate. [p]Preliminary. [r]Revised.
[1]Includes bauxite equivalent of nepheline syenite concentrates and alunite ore.

Table 15.—Leading world producers of aluminum

(Thousand metric tons)

Country	1975	1976	1977[p]
United States	3,519	3,857	4,117
U.S.S.R.[e]	1,530	1,600	1,640
Japan	1,013	919	1,188
Canada	887	633	962
Germany, Federal Republic of	678	697	742
Norway	595	597	628
France	383	385	389
United Kingdom	308	335	349
Italy	190	206	260
Australia	214	232	248
Netherlands	261	256	241
Spain	210	211	211
Romania	204	207	209
Total	9,992	10,135	11,184
All others	2,151	2,362	2,477
Grand total	12,143	12,497	13,661

[e]Estimate. [p]Preliminary.

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Table 16.—Leading world producers of chromite

(Gross weight, thousand metric tons)

Country	1975	1976	1977[p]
South Africa, Republic of	2,075	2,409	3,317
U.S.S.R.[e]	2,080	2,100	2,180
Albania[e]	779	830	880
Turkey[e]	[r]720	[r]710	630
Rhodesia, Southern[e]	590	610	600
Finland	332	414	594
Philippines	520	428	537
India	500	402	351
Total	7,596	7,903	9,089
All others	700	727	711
Grand total	8,296	8,630	9,800

[e]Estimate. [p]Preliminary. [r]Revised.

Table 17.—Leading world producers of mine copper

(Copper content of ore, thousand metric tons)

Country	1975	1976	1977[p]
United States[1]	1,282	1,457	1,364
Chile	828	1,005	1,056
U.S.S.R.[e 1 2]	765	800	830
Canada[1]	734	731	781
Zambia	677	709	658
Zaire	[r]495	444	482
Peru	193	220	350
Philippines	226	233	269
Poland	230	267	[e]268
Australia	219	218	220
South Africa, Republic of	179	197	208
Papua New Guinea	172	176	182
Total	6,000	6,457	6,668
All others	1,008	1,038	1,025
Grand total	7,008	7,495	7,693

[e]Estimate. [p]Preliminary. [r]Revised.
[1]Recoverable.
[2]Smelter production.

Table 18.—Leading world producers of gold

(Thousand troy ounces)

Country	1975	1976	1977[p]
South Africa, Republic of	22,938	22,936	22,502
U.S.S.R.[e]	7,500	7,700	7,850
Canada	1,654	1,692	1,717
Papua New Guinea	611	1,228	[e]1,300
United States	1,052	1,048	1,100
Rhodesia, Southern	[r]600	[r]600	600
Ghana	524	532	481
Australia	527	495	[e]475
Philippines	[r]503	501	558
Total	35,909	36,732	36,583
All others	2,567	2,910	2,802
Grand total	[r]38,476	39,642	39,385

[e]Estimate. [p]Preliminary. [r]Revised.

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Table 19.—Leading world producers of iron ore, iron ore concentrates, and iron ore agglomerates

(Thousand metric tons)

Country	1975	1976	1977[p]
U.S.S.R.	232,803	239,109	237,700
Australia	[r]97,651	93,255	96,098
Brazil	89,894	94,087	[e]87,000
China, People's Republic of[e]	65,000	65,000	65,000
United States	80,132	81,277	56,646
Canada	46,868	58,555	56,310
India	[r]41,405	43,443	42,307
France	49,647	45,181	36,634
South Africa, Republic of	[r]12,298	15,663	26,481
Sweden	30,867	29,862	25,416
Liberia	[e]24,000	18,814	18,136
Venezuela	24,772	18,685	14,400
Mauritania	[r]8,677	9,664	9,794
Korea, North[e]	9,400	9,500	9,500
Chile	[r]11,007	10,055	7,896
Total	824,421	832,150	789,318
All others	77,598	68,199	67,810
Grand total	902,019	900,349	857,128

[e]Estimate. [p]Preliminary. [r]Revised.

Table 20.—Leading world producers of crude steel[1]

(Thousand metric tons)

Country	1975	1976	1977[p]
U.S.S.R.	141,325	144,805	147,000
United States	105,816	116,120	113,700
Japan	102,313	107,399	102,405
Germany, Federal Republic of	40,415	42,415	38,985
China, People's Republic of[e]	[r]25,000	25,000	27,000
Italy	21,836	23,447	23,334
France	21,530	23,221	22,090
United Kingdom	20,198	22,244	[e]21,176
Poland	15,007	15,640	17,844
Czechoslovakia	14,323	14,693	[e]15,091
Canada	13,025	13,326	13,631
Romania	9,549	10,733	11,600
Belgium-Luxembourg	11,587	12,149	11,257
Spain	[r]11,137	10,910	[e]10,856
Australia	7,843	7,774	7,313
Total	560,904	589,876	583,282
All others	82,895	87,487	90,413
Grand total	643,799	677,363	673,695

[e]Estimate. [p]Preliminary. [r]Revised.
[1]Steel ingots and castings.

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Table 21.—Leading world producers of mine lead

(Lead content of ore, thousand metric tons)

Country	1975	1976	1977[p]
United States[1]	564	553	537
U.S.S.R.[e]	480	500	510
Australia	408	399	434
Canada	349	256	284
Peru[1]	184	160	166
Mexico[1]	179	200	163
Yugoslavia	127	122	137
Bulgaria[e]	114	117	115
Korea, North[e]	120	120	110
China, People's Republic of[e]	100	100	100
Total	2,625	2,527	2,556
All others	809	812	858
Grand total	3,434	3,339	3,414

[e]Estimate. [p]Preliminary.
[1]Recoverable.

Table 22.—Leading world producers of manganese ore

(Gross weight, thousand metric tons)

Country	1975	1976	1977[p]
U.S.S.R.	8,459	8,636	8,500
South Africa, Republic of	5,769	5,452	5,048
Gabon	[r]2,245	2,217	1,851
India	[r]1,577	1,760	1,774
Australia	1,555	2,154	1,387
China, People's Republic of[e]	1,000	1,000	1,000
Brazil	2,156	1,696	900
Mexico	428	453	487
Ghana	409	312	267
Hungary	182	165	161
Total	23,780	23,845	21,375
All others	876	753	644
Grand total	[r]24,656	24,598	22,019

[e]Estimate. [p]Preliminary. [r]Revised.

Table 23.—Leading world producers of mine nickel

(Thousand metric tons)

Country	1975	1976	1977[p]
Canada	242	241	235
U.S.S.R.[e]	[r]152	160	168
New Caledonia	[r]133	119	109
Australia	76	83	86
Cuba[e]	37	[r]37	37
Dominican Republic	27	24	24
Total	667	664	659
All others	141	157	137
Grand total	808	821	796

[e]Estimate. [p]Preliminary. [r]Revised.

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Table 24.—Leading world producers of mine tin

(Tin content of ore, metric tons)

Country	1975	1976	1977[p]
Malaysia	64,364	63,401	58,703
U.S.S.R.[e]	30,000	31,000	33,000
Bolivia	[r]24,333	29,812	32,616
Indonesia	[r]25,337	23,435	24,021
Thailand	16,406	20,452	24,205
China, People's Republic of[e]	22,000	20,000	20,000
Australia	[r]9,577	10,109	9,968
Zaire	4,562	[e]4,000	[e]3,607
Nigeria	4,652	3,710	3,267
Total	201,231	205,919	209,387
All others	21,052	22,086	22,051
Grand total	222,283	228,005	231,438

[e]Estimate. [p]Preliminary. [r]Revised.

Table 25.—Leading world producers of mine zinc

(Zinc content of ore, thousand metric tons)

Country	1975	1976	1977[p]
Canada	1,229	1,145	1,300
U.S.S.R.[e]	690	720	735
Australia	501	468	492
United States	426	440	408
Peru	385	396	405
Japan	254	260	276
Mexico	289	259	265
Poland[e]	210	180	180
Korea, North[e]	160	150	150
Sweden	111	128	136
Germany, Federal Republic of	116	115	114
Yugoslavia	103	107	107
China, People's Republic of[e]	100	100	100
Greenland	91	81	77
Spain	85	85	93
Total	4,750	4,634	4,838
All others	1,102	1,137	1,224
Grand total	[r]5,852	5,771	6,062

[e]Estimate. [p]Preliminary. [r]Revised.

Table 26.—Leading world producers of hydraulic cement

(Thousand metric tons)

Country	1975	1976	1977[p]
U.S.S.R.	[r]122,057	124,246	127,000
Japan	65,517	68,712	73,138
United States	[r]63,250	67,581	72,627
China, People's Republic of[e]	30,000	[r]30,000	40,000
Italy	34,235	36,327	38,204
Germany, Federal Republic of	[r]33,500	34,155	32,163
France	29,588	29,394	28,737
Spain (including Canary Islands)	[r]24,093	25,202	27,995
Poland	18,500	19,800	21,300
India	[r]16,236	18,684	19,060
Brazil	17,437	19,147	18,455
United Kingdom	[r]16,891	15,780	15,458
Korea, Republic of	10,129	11,873	14,198
Romania	11,520	12,548	13,875
Turkey	[r]10,692	12,382	13,833
Mexico	11,612	12,584	13,227
German Democratic Republic	[r]10,657	11,344	12,096
Total	525,914	549,759	581,366
All others	176,224	185,632	196,019
Grand total	[r]702,138	735,391	777,385

[e]Estimate. [p]Preliminary. [r]Revised.

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Table 27.—Leading world producers of diamond[1]

(Thousand carats)

Country	1975	1976	1977[p]
Zaire	12,810	11,821	11,213
U.S.S.R.[e]	9,700	9,900	10,300
South Africa, Republic of	7,295	7,022	8,033
Botswana	2,397	2,354	2,691
Ghana	2,328	2,283	[e]2,300
South-West Africa, Territory of	[r]1,748	1,694	2,001
Total	36,278	35,105	36,538
All others	4,586	2,968	2,932
Grand total	[r]40,864	38,073	39,470

[e]Estimate. [p]Preliminary. [r]Revised.
[1]Gem and industrial grades undifferentiated.

Table 28.—Leading world producers of nitrogen fertilizer compounds[1]

(Thousand metric tons of contained nitrogen)

Country	1975	1976	1977[p]
United States	8,474	9,591	9,790
U.S.S.R.	7,806	8,467	8,531
China, People's Republic of[e]	2,899	2,960	3,600
India	1,187	1,508	1,857
Poland	1,458	1,533	1,548
France	1,694	[e]1,361	[e]1,462
Romania	980	1,292	1,331
Germany, Federal Republic of	1,574	1,259	1,290
Netherlands	1,334	[e]1,154	[e]1,253
Japan	[e]2,341	1,557	1,149
United Kingdom	997	1,055	[e]1,071
Italy	1,131	1,000	985
Total	31,875	32,737	33,867
All others	10,566	11,073	11,999
Grand total	42,441	43,810	45,866

[e]Estimate. [p]Preliminary.
[1]Year ending June 30 of that stated.

Table 29.—Leading world producers of phosphate rock[1]

(Thousand metric tons)

Country	1975	1976	1977[p]
United States	[r]44,276	44,662	47,256
U.S.S.R.[e 2]	24,150	24,200	24,200
Morocco	13,548	15,656	17,027
China, People's Republic of[e]	3,400	3,750	4,100
Tunisia	[r]3,481	3,294	3,614
Spanish Sahara	[r]2,682	173	232
Total	91,537	91,735	96,429
All others	16,141	15,905	19,543
Grand total	107,678	107,640	115,972

[e]Estimate. [p]Preliminary. [r]Revised.
[1]Includes output of all major crude mineral sources of phosphate.
[2]Includes material described as sedimentary rock in Soviet sources.

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Table 30.—Leading world producers of marketable potash

(Thousand metric tons K_2O equivalent)

Country	1975	1976	1977[p]
U.S.S.R.	7,944	8,310	8,500
Canada	5,436	4,996	6,089
German Democratic Republic	3,019	3,161	[e]3,244
Germany, Federal Republic of	2,223	2,036	2,341
United States	2,269	2,177	2,229
France	1,920	1,600	[e]1,580
Total	22,811	22,280	23,983
All others	1,928	1,979	1,789
Grand total	24,739	24,259	25,772

[e]Estimate. [p]Preliminary.

Table 31.—Leading world producers of salt

(Thousand metric tons)

Country	1975	1976	1977[p]
United States (including Puerto Rico)	37,246	40,114	39,407
China, People's Republic of[e]	29,940	30,000	30,000
U.S.S.R.[e]	13,700	14,000	15,500
Germany, Federal Republic of	9,316	11,822	[e]12,409
United Kingdom	7,630	8,006	[e]8,000
France	5,538	6,416	[e]6,500
Canada	[r]4,835	5,994	5,933
Australia	4,660	[e]4,700	[e]4,800
Mexico	5,354	4,591	[e]4,500
Romania	3,833	4,210	[e]4,500
Italy	4,411	4,013	[e]4,200
Poland	[r]3,524	3,818	[e]3,900
Spain	3,132	3,158	[e]3,200
Netherlands	2,690	3,026	3,111
German Democratic Republic	2,430	2,560	[e]2,600
Brazil	2,145	2,473	[e]2,500
India	[r]4,856	3,068	1,757
Bahamas	1,233	1,353	1,670
Japan	1,012	1,021	1,056
Argentina	1,567	661	704
Colombia	926	708	614
Total	149,978	155,712	156,861
All others	11,675	12,454	13,096
Grand total	161,653	168,166	169,957

[e]Estimate. [p]Preliminary. [r]Revised.

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Table 32.—Leading world producers of elemental sulfur[1]

(Thousand metric tons)

Country	1975				1976				1977[p]			
	Native	From pyrite	Byproduct	Total	Native	From pyrite	Byproduct	Total	Native	From pyrite	Byproduct	Total
United States	[e]7,326	241	3,872	11,439	[2]6,365	291	4,222	10,878	[2]5,916	118	4,642	10,676
U.S.S.R.[e]	[r 3]2,190	3,200	2,590	7,980	[3]2,700	3,300	3,140	9,140	[3]2,900	3,300	3,340	9,540
Canada	--	11	7,525	7,536	--	16	7,205	7,221	--	10	7,336	7,346
Poland	[3]4,771	--	310	5,081	[3]4,891	--	315	5,206	[3]4,765	--	325	5,090
Japan	--	538	1,951	2,489	--	470	2,177	2,647	--	389	2,436	2,825
France	--	--	1,993	1,993	--	--	1,968	1,968	--	--	2,160	2,160
Mexico	[2]2,074	--	142	2,216	[2]2,054	--	171	2,225	[2]1,723	--	213	1,936
Germany, Federal Republic of	--	221	1,061	1,282	--	233	1,130	1,363	--	235	1,367	1,602
Spain	--	1,264	107	1,371	--	1,070	128	1,198	--	1,102	141	1,243
China, People's Republic of[e]	90	900	80	1,070	90	900	90	1,080	90	950	100	1,140
Italy	52	423	228	703	35	374	211	620	63	380	259	702
Iraq	[2]600	--	110	710	[2]610	--	65	675	[2]620	--	55	675
Finland	--	246	361	607	--	234	391	625	--	235	335	570
Iran	20	--	475	495	20	--	399	419	20	--	527	547
Romania	--	375	90	465	--	375	98	473	--	395	110	505
South Africa, Republic of	--	260	105	365	--	294	118	412	--	332	133	465
Bulgaria	--	170	77	247	--	280	60	340	--	305	65	370
Sweden	--	211	143	354	--	205	158	363	--	204	158	362
German Democratic Republic	--	10	355	365	--	10	243	253	--	10	340	350
Yugoslavia	--	145	185	330	--	185	205	390	--	166	175	341
Korea, North	--	260	16	276	--	245	20	265	--	250	12	262
Belgium	--	--	196	196	--	--	248	248	--	--	257	257
Australia	--	106	149	255	--	108	150	258	--	107	142	249
Total	17,123	8,581	22,121	47,825	16,765	8,590	22,912	48,267	16,097	8,488	24,628	49,213
All others	123	941	1,297	2,361	124	871	1,229	2,224	114	736	1,345	2,195
Grand total	17,246	9,522	23,418	50,186	16,889	9,461	24,141	50,491	16,211	9,224	25,973	51,408

[e]Estimate. [p]Preliminary. [r]Revised.

[1]This table includes all recorded production of sulfur, regardless of the form in which it is recovered. Thus, it includes elemental sulfur, whether mined by conventional methods or by the Frasch process, as well as (1) elemental sulfur and the sulfur content of compounds such as H_2S, SO_2, and H_2SO_4 recovered as a principal product of pyrite mining and as a byproduct of the recovery of crude oil and natural gas and as a byproduct of petroleum refining, coal treatment, and metals smelting and/or refining; and (2) sulfur recovered from tar sands, spent oxides, and other miscellaneous sources.

[2]Entirely Frasch-process sulfur.

[3]Includes Frasch-process sulfur as follows, in thousand metric tons: Poland: 1975—4,321, 1976—4,341, 1977—4,405; U.S.S.R. (estimated): 1975—320, 1976—500, 1977—500; total of individually listed countries and grand total: 1975—14,641, 1976—13,870 1977—13,164. The balance is mined elemental sulfur.

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Table 33.—Leading world producers of coal (all grades)

(Million metric tons)

Country	1975			1976			1977[p]		
	Lignite	Bituminous and anthracite	Total	Lignite	Bituminous and anthracite	Total	Lignite	Bituminous and anthracite	Total
U.S.S.R.	164	[r]538	[r]702	164	548	712	165	557	722
United States	18	576	594	23	598	621	27	604	631
China, People's Republic of[e]	[1]	470	470	[1]	480	480	[1]	500	500
German Democratic Republic	247	1	248	247	[2]	247	254	[2]	254
Poland	40	172	212	39	179	218	41	186	227
Germany, Federal Republic of	123	92	215	134	89	223	123	85	208
United Kingdom	--	[r]129	[r]129	--	124	124	--	[e]122	[e]122
Czechoslovakia	87	28	115	89	28	117	93	28	121
Australia	[r]28	[r]67	[r]95	31	75	106	29	78	107
India	3	96	99	4	101	105	4	100	104
South Africa, Republic of	--	69	69	--	77	77	--	85	85
Korea, North[e]	[1]	40	40	[1]	41	41	[1]	41	41
Yugoslavia	[r]35	1	[r]36	36	1	37	39	1	40
Canada	4	22	26	5	21	26	5	23	28
Romania	20	7	27	18	[e]7	[r]25	[e]20	[e]7	[e]27
Hungary	22	3	25	22	3	25	23	3	26
Bulgaria	28	[2]	28	25	[2]	25	25	[2]	25
France	3	22	25	3	22	25	3	22	25
Total	[r]822	[r]2,333	[r]3,155	840	2,394	3,234	851	2,442	3,293
All others	[r]35	[r]90	[r]125	44	91	135	45	95	140
Grand total	[r]857	[r]2,423	[r]3,280	884	2,485	3,369	896	2,537	3,433

[e]Estimate. [p]Preliminary. [r]Revised.
[1]Output small, included under "Bituminous and anthracite."
[2]Less than 1/2 unit.

Table 34.—Leading world producers of marketed[1] natural gas

(Billion cubic feet)

Country	1975	1976	1977[p]
United States	20,109	19,952	20,035
U.S.S.R.	10,206	11,334	12,219
Netherlands	3,208	3,436	3,422
Canada	3,090	3,097	3,161
China, People's Republic of[e]	1,400	1,600	1,900
United Kingdom	1,274	1,316	1,437
Romania	1,042	1,136	1,104
Iran	771	794	748
Germany, Federal Republic of	639	658	638
Mexico	584	578	600
Libya	383	487	556
Venezuela	450	480	524
Italy	514	553	485
German Democratic Republic	257	305	[e]317
Algeria	337	351	305
Argentina	278	291	304
Total	44,542	46,368	47,755
All others	2,822	3,129	3,639
Grand total	47,364	49,497	51,394

[e]Estimate. [p]Preliminary.
[1]Comprises all gas collected and utilized as a fuel or as a chemical industry raw material as well as that used for gas lift in fields, including gas used in oilfields and/or gasfields as a fuel by producers, even though it is not actually sold. Excludes gas produced and subsequently vented, flared, or reinjected to reservoirs.

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Table 35.—Leading world producers of natural gas liquids

(Million 42-gallon barrels)

Country[1]	1975	1976	1977[p]
United States	596	587	590
U.S.S.R.[e]	90	100	110
Canada	112	105	106
Saudi Arabia	51	66	[e]70
Mexico	33	34	38
Venezuela	[r]29	25	29
Total	911	917	943
All others	126	142	143
Grand total	1,037	1,059	1,086

[e]Estimate. [p]Preliminary. [r]Revised.

[1]In addition to the countries listed, the People's Republic of China may also produce natural gas liquids, but available information is inadequate to make reliable estimates of output levels. Every effort has been made to include in this table only those natural gas liquids produced by natural gas processing plants, and to exclude natural gas liquids obtained from field treatment facilities including wellhead separators, because the latter are normally blended with crude oil and thus are included in crude oil statistics output. In some cases, however, sources do not clearly specify whether data presented represent only output of natural gas processing plants or if they include field output. Thus, some of the figures in this table may include field condensate.

Table 36.—Leading world producers of crude oil

(Million 42-gallon barrels)

Country	1975	1976	1977[p]
U.S.S.R.	3,609	3,822	3,991
Saudi Arabia	[r]2,583	3,139	3,358
United States	[r]3,057	2,976	3,009
Iran	1,953	2,168	2,080
Iraq	826	884	909
Venezuela	856	840	817
Nigeria	652	756	765
Libya	551	704	753
United Arab Emirates	618	713	730
Kuwait	[r]761	786	719
China, People's Republic of[e]	572	646	653
Indonesia	477	550	615
Canada	521	489	482
Algeria	351	384	410
Mexico	294	327	358
United Kingdom	8	89	272
Qatar	159	182	162
Australia	[r]150	153	157
Argentina	144	146	157
Egypt	84	120	151
Oman	[r]125	134	124
Romania	109	110	109
Norway	69	102	102
Gabon	82	82	81
Total	[r]18,611	20,302	20,964
All others	[r]891	890	937
Grand total	[r]19,502	21,192	21,901

[e]Estimate. [p]Preliminary. [r]Revised.

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Table 37.—Leading world producers of refined oil

(Million 42-gallon barrels)

Country	1975	1976	1977[p]
United States (including Puerto Rico and Virgin Islands)	5,091	5,479	5,922
U.S.S.R.	2,925	3,037	3,325
Japan	1,616	1,681	1,701
France	809	902	892
Italy	740	795	812
Germany, Federal Republic of	726	821	772
United Kingdom	690	723	695
Canada	624	625	659
China, People's Republic of[e]	[r]391	550	600
Netherlands	423	480	448
Brazil	330	348	358
Spain (including Canary Islands)	317	376	355
Venezuela	317	360	354
Mexico	248	274	305
Iran	251	255	274
Belgium	214	213	269
Saudi Arabia[1]	158	257	262
Australia	209	215	226
Singapore	139	173	217
Netherlands Antilles	221	226	198
India	161	168	181
Argentina	158	166	177
Romania	132	135	176
Korea, Republic of	118	132	158
Kuwait[1]	144	173	141
Total	17,152	18,564	19,477
All others	2,522	2,706	2,910
Grand total	19,674	21,270	22,387

[e]Estimate. [p]Preliminary. [r]Revised.
[1]Includes the country's share of production from the Kuwait-Saudi Arabia Partitioned Zone.

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Ocean Minerals

By William T. Cocke[1]

Nickel, copper, cobalt, and manganese are among the minerals found in iron-manganese concretions, or nodules, on the deep sea floor. These small potato-shaped seabed nodules are found in large quantities in areas of the Atlantic, Pacific, and Indian Oceans. Generally black in color, they consist of concentric bands of ferromanganese oxides around nuclei of sharks' teeth, coral, pumice, various forms of silica, and other diverse hard objects found on the seabed. The nodules range in diameter from 0.5 to 20 centimeters or larger.

Seabed nodules are found at ocean depths of generally 2,000 to 6,000 meters and in many types of environments, including seamounts, plateaus, ridges, banks, continental borderlands, and abyssal depths. Concentrations of nodules on the seabed vary widely with location and are as high as 25 kilograms per square meter in some regions. There is also a great variation in the chemical composition of the nodules; percentages of contained nickel, copper, cobalt, manganese, and other metals vary both locally and regionally.

The discovery of these ocean nodules dates back to the 1872-76 voyages of the *HMS Challenger*. Although nodule studies have been going on for 100 years, more intensive interest has taken place since the middle to late 1950's. As early as 1952, seabed nodules were recognized as a potential mineral resource by Dr. John Mero of the Institute of Marine Resources, University of California, and by 1961 he had published chemical compositions of Pacific nodules.

Exploration of seabed nodule deposits has been carried out since 1962. Most studies have been made in the Equatorial North Pacific Ocean, which is believed to contain the most economically feasible concentrations of nodules with high metal content. The high-grade nodules in economic concentrations were found in the pelagic sediments of the Pacific. In the early 1960's, the colloidal or hydrogenous theory of nodule origin was considered.[2] It was believed that seawater, saturated with iron and manganese, precipitates colloidal microparticles that increase in size as they slowly settle to the ocean floor. As they settle, the microparticles attract ions of elements such as nickel, copper, and cobalt, all of which have high electric charge density. These microparticles are then attracted to centers of accretion forming iron- and manganese-rich nodules in areas of low sedimentation, such as the red-clay pelagic zones of the abyssal Pacific. Although nodules may also form by this process in the Atlantic and Indian Oceans, those in these Oceans' areas are generally considered of less importance from an economic standpoint. Other theories of origin have been advanced, and current theories suggest that a number of mechanisms may contribute to the ferromanganese deposition in the form of seabed nodules.[3]

Exploration of the seabed nodule deposits has been accomplished by underwater photographic methods involving both television and still cameras and by bottom-sampling methods utilizing dredges, cores, and grabs. The photographic methods are used to establish concentrations of nodules and areas of extent. The bottom samples are analyzed for metal content and physical size.

The nickel-copper-cobalt content, as well as seabed concentration, is far from uniform. In 1965, Mero published data on this variation of nodule composition in the Pacific.[4] The composition, while locally erratic, shows marked regional trends of enrichment or depletion of the nickel, copper, cobalt, and manganese content, which are not distinct owing to sparsity of data. Delin-

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eation becomes more defined, however, as more samples are collected.

Industry interest in ocean mining projects was precipitated in 1962 by the announcement that Summa Corp. was to begin seabed nodule exploration aboard the *Glomar Explorer*.[5] In 1968, another Global Marine Development Co. ship, *Glomar Challenger*, began the Deep Sea Drilling Project, under which ocean basins have been drilled to great depths at numerous locations. In the early 1970's, the *R/V Prospector* operated by Deepsea Ventures Inc. (DSV) dredged nodules from the Blake Plateau in the Atlantic Ocean. The West German ship *R/V Valdivia* began working with the *Prospector* and later continued on its own deep ocean mining program.

In 1974, international ocean mining consortia began to form to share the high cost of financing development and testing of ocean mining schemes. At this time, DSV made a claim to the U.S. Department of State for a minesite in the Northeast Pacific.[6]

With the accumulation of more data, seabed nodule resources were estimated for the Northeast Pacific, primarily in the area between the Clarion and Clipperton fracture zones between Hawaii and Baja, Calif. Gross estimates of nodule resources were as high as 1 trillion tons.[7] Other estimates, based on various parameters, ranged from 270 million to 70 billion tons.[8]

It can be inferred from the numerous analyses of nodules in the Northeast Pacific that a typical grade of an economic deposit would average 1.3% nickel, 1.1% copper, 0.25% cobalt, and 25% manganese. The following table shows average grades, in percent, of North Pacific nodules based on various published analyses:

Source and date	Nickel	Copper	Cobalt	Manganese
Mero, 1965	0.99	0.53	0.35	24.2
Cronan, 1972	1.08	.63	.19	22.3
United Nations, 1973	1.28	1.16	.23	24.6
United Nations, 1974	1.6	1.4	.21	24.0
Deepsea Ventures Inc., 1974	1.28	1.07	.25	--
Kennecott Copper Corp., 1975	1.3	1.1	.2	30.0
Metallgesellschaft AG, 1975	1.36	1.2	.2	29.8
U.S. Department of Interior, 1976	1.5	1.3	.25	--
Centre National pour l'Exploitation des Oceans (CNEXO), 1977	1.22	1.03	.24	--
Tinsley, 1977	1.3	1.1	.25	29.0

In addition to industry activity, several governments were funding or sponsoring nodule research, exploration, and development. The West German Government was the first to fund substantial nodule exploration and development and has financed much of the activity of Arbeitsgemeinschaft Meerestechnischgewinnbare Rohstoffe (AMR) since 1971.[9] The Japanese Government financed the construction of a marine geological survey vessel and contributed to its operation and to the development of mining and processing systems. The French Government, through Centre National pour l'Exploitation des Oceans (CNEXO), Commissariat à l'Énergie Atomique (CEA), and Bureau de Recherches Géologiques et Minières (BRGM), supported extensive exploration programs, as well as development of mining and processing technology for seabed nodules. The Canadian Government established a marine resources group to monitor the development of seabed nodule mining and to assess its effect on the mineral industry of Canada. The United Kingdom and the U.S.S.R. also sponsored ocean mining research and development.

Agencies of the U.S. Government have administered seabed nodule programs since 1969. The National Oceanic and Atmospheric Administration (NOAA) sponsored environmental studies of nodule mining and processing and monitored major tests of nodule mining systems. Early studies led to the establishment of NOAA's Deep Ocean Mining Environmental Study (DOMES). The potential of nodule mineral resources led the National Science Foundation's Office of International Decade of Ocean Exploration (IDOE) to sponsor a conference, "Ferromanganese Deposits on the Ocean Floor," in January 1972. The geological, economic, legal, environmental, and technical aspects of seabed nodule mineral development were reviewed at the conference.[10] The Ocean Mining Administration (OMA), established in 1975 in the U.S. Department of the Interior, conducted nodule resource assessment and economic analysis of nodule mining. The U.S. Bureau of Mines provided technical support to OMA and conducted research on metallurgical processing and recovery of metals from the nodules.

In addition to the deep ocean mining of

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nodules in international waters, there has also been interest in offshore mineral resources within Territorial waters. Mineral activities in these areas include dredging of sand and gravel, mining of phosphoritic and barite deposits, installation of sulfur wells (Frasch process), and mining of alluvial and placer deposits (gold, tin, and diamond), iron sands, and metalliferous brines.

LAW OF THE SEA

In 1967, following previous conferences in 1958 and 1960, the U.N. General Assembly created an ad hoc committee of 35 nations to study the question of uses of seabed resources in the interest of mankind. This Seabed Committee met several times from 1969 to 1973 to prepare a draft text of treaty articles to serve as a basis for negotiations for the Third U.N. Conference on Law of the Sea (UNCLOS III). The principle of the common heritage of mankind was first advanced in these articles. This concept was originally construed to eliminate any sovereignty over seabed resources, but interpretations vary on its legal bearing. Some maintain that while the seabed resources belong to everyone, they belong to no individual, and others believe that the principle is not in opposition to high seas rights which means the seabed resources belong to anyone. The U.N. Seabed Committee also proposed three committees for UNCLOS III, based on its three subcommittees. Committee I dealt with matters relating to the seabed. Committee II handled problems relating to navigation through international straits, limits of the territorial sea and exclusive economic zone, the contiguous zone, legal limits of the continental shelf, conservation of living resources, and preferential rights of coastal states. Committee III dealt with matters relating to the marine environment, marine pollution and scientific research, and the right of innocent passage.

The first five sessions of UNCLOS III met with little success. During the Fifth Session in August and September 1976, a deadlock resulted from the position taken by the bloc of developing nations known as the Group of 77. This Group considered the system of exploitation of the seabed set forth in Committee I texts unacceptable and rejected the Revised Single Negotiating Text (RSNT), which had resulted from the previous session and which represented a consensus of a large number of issues before the Conference.

On March 3, 1977, Elliot L. Richardson was appointed by President Carter to serve as Ambassador at Large and Special Representative of the President to UNCLOS III. He replaced T. Vincent Learson as chairman of the U.S. delegation.

The Sixth Session of UNCLOS III was held at U.N. headquarters in New York City from May 23 to July 15, 1977. Based on decisions made at the end of the Fifth Session and during informal consultations held in Geneva earlier in 1977, the entire Conference directed its attention to major seabed mining issues during the first 3 weeks. This work was coordinated by Minister Jens Evensen of Norway, who had led earlier sessions and intersessional consultations on the subject. Successive revised texts were produced for consideration, and the evolution of the Evensen texts suggested that the negotiating process was moving closer to a consensus. However, at the end of the session, Committee I Chairman Paul Engo of Cameroon, rather than submitting the Evensen compromise formula, submitted his own versions as the Committee I text of the Informal Composite Negotiating Text (ICNT). Coming unilaterally and not from negotiations, the Engo texts upset the balance achieved by Evensen and were considered "fundamentally unacceptable to the U.S." by Ambassador Richardson and the U.S. delegation.[11] The substantive difficulties were that the United States was not given reasonable assurance of access to minesites and that technology transfer and joint ventures with the International Seabed Authority (ISA) were conditions of access. The United States had agreed earlier to the RSNT, a compromise proposal, for financing the ISA through a partial or dual system of exploitation that would allow access to State and private operators in addition to the Enterprise, the operating arm of the ISA. Other problems with the ICNT were absence of reasonable limits on financial burdens (revenue sharing), production limitations more stringent than necessary to protect producers from specific countries, unacceptable power given to the ISA to regulate all other seabed mineral production, distribution of benefits to countries not party to the Conference, and, unless agreement to the contrary was

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reached within 25 years, automatic conversion of the regime into a unitary system blocking direct access to all but the ISA, except by its consent.

The ICNT was considered by the U.S. delegation to be further from an acceptable compromise than the RSNT derived from the previous session.

U.S. DEEP SEABED MINING LEGISLATION

Since November 2, 1971, when Senator Metcalf of Montana introduced S. 2801, there has been a succession of bills in both houses of Congress to provide authority for the development of the hard mineral resources of the deep seabed. S. 2801 was an outgrowth of a series of hearings before the Special Subcommittee on the Outer Continental Shelf of the Senate Committee on Interior and Insular Affairs. Testimony indicated that U.S. industry was nearing mining capability and that domestic legislation was needed.

Various proposed bills outlined the establishment of a regulatory system to promote the orderly development of deep seabed hard minerals. They included provisions for exploration licenses and permits for commercial exploitation. Enforcement procedures for protection of the marine environment in accordance with established criteria and standards relating to environmental impact statements were also proposed. The proposed bills were to be interim in nature, pending the establishment of an international regulatory regime resulting from UNCLOS III or another multinational treaty.

On February 9, 1977, Representatives John Murphy of New York and John Breaux of Louisiana introduced H.R. 3350, which was referred jointly to the House Committee on Merchant Marine and Fisheries and the House Committee on Interior and Insular Affairs. Hearings were held in March, April, and May before the Subcommittee on Oceanography of the House Committee on Merchant Marine and Fisheries, and the bill was reported from the Committee with amendments on August 9, 1977. On November 7, 1977, H.R. 3350 was reported from the House Committee on Interior and Insular Affairs with amendments and referred to the House Committee on International Relations for a period ending February 10, 1978.

On August 5, 1977, Senator Metcalf introduced S. 2053, which was referred jointly to the Senate Committee on Commerce, Science, and Transportation and the Senate Committee on Energy and Natural Resources. Joint hearings were held in September.

The Administration announced support of seabed mining legislation following the close of the Sixth Session of UNCLOS III. However, it opposed the provision in both bills calling for U.S. investment guarantees covering industry losses stemming from an unfavorable Law of the Sea treaty. In lieu of such guarantees in domestic legislation, the Administration favored a "grandfather rights" clause in the prospective UNCLOS III treaty.

OCEAN MINING CONSORTIA

As early as 1962, industry interest in ocean mining had developed to the point where Kennecott Copper Corp. and Tenneco Inc. were funding projects. From 1962 to 1968, efforts were confined primarily to mineral resource research, data collection, mining system design, economic feasibility studies, and bench-scale process testing.

During the period 1969-74, preliminary engineering development of deep seabed mining systems was underway. Companies active during this period were Kennecott, DSV, Lockheed Missiles and Space Co., Inco Ltd. (Canada), Metallgesellschaft AG (Federal Republic of Germany), CNEXO (France), and several Japanese companies.

In late 1974, major organizational changes took place among operating companies during a period of demonstrating feasibility by trial mining and processing. Because of the high capital costs involved, international mining consortia were formed to finance these endeavors. Since 1975, the industry has been involved in the study of the technological and economic feasibility of ocean mining, trial mining tests, and demonstration of pilot processing plants. Table 1 shows the structure of the various major international consortia.

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Table 1.—Major oceanmining consortia and other joint ventures

Consortium	Nationality
Kennecott Consortium:	
BP Minerals Ltd. (British Petroleum Co. Ltd.)	United Kingdom.
Consolidated Gold Fields Ltd	____do.
Kennecott Exploration Inc. (Kennecott Copper Corp.)	United States.
Mitsubishi Corp	Japan.
Noranda Mines Ltd	Canada.
Rio Tinto-Zinc Corp. Ltd	United Kingdom.
Ocean Management Inc. (OMI):[1]	
Arbeitsgemeinschaft Meerestechnischgewinnbare Rohstoffe (AMR)	Federal Republic of Germany (4 companies).
Deep Ocean Mining Co. (DOMCO)	Japan (12-15 companies).
Inco Ltd	Canada.
Sedco Inc	United States.
Ocean Mining Associates (OMA):	
Deepsea Ventures Inc. (DSV)[2]	____do.
Essex Minerals Co. (United States Steel Corp.)	____do.
Sun Ocean Ventures Inc. (Sun Co. Inc.)	____do.
Union Seas Inc. (Union Minière S.A.)	Belgium-Luxembourg.
Ocean Minerals Co. (OMINCO):	
Amoco Minerals Co. (Standard Oil Co. (Indiana))	United States.
Billiton International Metals B.V. (Royal Dutch/Shell)	Netherlands.
BKW Ocean Minerals B.V. (Bos Kalis Westminster Group N.V.)	____do.
Lockheed Missiles and Space Co. (Lockheed Corp.)	United States.
Deep Ocean Minerals Association (DOMA)	Japan (about 30 companies).
Association Française pour l'Étude et la Recherche des Nodules (AFERNOD)	France (State agencies and private companies).
Germinal[3]	____do.
Continuous Line Bucket Group (CLB)	Australia, Canada, France, Federal Republic of Germany, Japan, and United States (about 20 companies).
EurOcean	France, Netherlands, and Sweden (5 companies).

[1]Management contract.
[2]Service contract.
[3]Offshore minerals.

Kennecott Consortium.—The Kennecott Consortium was the first international consortium formed to investigate the recovery and processing of seabed nodules. It was formalized in January 1974 to undertake a 5-year program of study.[12] Kennecott Exploration Inc. was to manage this unincorporated joint venture. Marne A. Dubs was director of Kennecott's Ocean Resources Group, part of the Corporate Exploration Group. Seagoing operations were centered in the Ocean Operating Division, which was formed in 1962. This division sponsored exploratory cruises before putting to sea itself in 1967. Kennecott was an early proponent of free-fall sampling devices. In 1970, a 5-ton dredge bucket was used to recover 50 tons of nodules from 4,600-meter depths.[13] The company was also active in box-core sampling and seafloor photography. Two large areas in the Pacific Ocean that showed favorable mineral abundance and grade were located and explored.[14]

A 2,000-ton-per-day nodule-collecting device, towed by cable, was tested at 4,600-meter depths in the Pacific.[15] In 1976, a test (1/10 of commercial scale) was made to depths of 5,000 meters. Although no nodules were recovered, as the recovery pipestring was not tested, the device demonstrated efficiency for nodule recovery, with collection of 90% of available nodules in the path of the mining device. Kennecott favored an inline hydraulic system, employing a 50-centimeter-diameter pipe capable of mining 5,000 to 15,000 tons per day or 3 million tons per year.[16] Initial large-scale tests (1/3 to 1/2 scale), scheduled for 1977, were postponed until 1978, reportedly owing to the prevailing weak metal market and lack of progress in UNCLOS III. A mid-1978 test of inline submerged hydraulic pumps was ex-

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pected, with full-scale integrated testing by 1979 of a towed dredge at the end of a nearly vertical pipestring.[17] Presumably, a modified drillship or other ship conversion would be used, but no announcement was made concerning vessel selection. Kennecott was also reportedly working on self-propelled sea-bottom nodule collectors.

Kennecott conducted extensive nodule-processing tests at its Ledgemont Laboratory in Lexington, Mass. In 1973, a 0.5-ton-per-day pilot processing plant was operated, and by early 1974 Kennecott had essentially finished nodule-processing research. Kennecott has developed several unique hydrometallurgical techniques; the ammonia-based "cuprous ion" (Cuprion) metal extraction process was preferred. Recovery was claimed to be 90% for nickel, 92% for copper, and 85% for cobalt. Kennecott also considered recovery of incremental amounts of manganese from the Cuprion process tailings, depending on market conditions.[18]

Ocean Management Inc. (OMI).—This group was formalized in April 1975 and embarked on a 4-year study program budgeted at $33 million. John L. Shaw was president of OMI, which had the management contract for the consortium. Each of the members had considerable experience in ocean mining and related technology. Most had been participants in the Continuous Line Bucket Group. Sedco Inc., which joined the group in November 1975, began ocean mining studies in 1966. Inco began investigation of seabed nodules in the early 1960's, concentrating on resource assessment, but did little exploration on its own. Most of the exploration data was from the West German AMR Group, which used the *R/V Valdivia*, a 1,980-ton stern trawler modified in 1970. AMR was founded in 1972 for deep ocean exploration, mining, and processing and to expand on the survey work conducted by Metallgesellschaft. AMR identified several minesites in the Northeast Pacific that OMI considered suitable for ocean mining.

Some sophisticated mining methods were suggested and developed by AMR. Models of collector devices were suggested by the four partners. No lift technique was decided upon, but Inco was apparently planning tests of pump and/or airlift hydraulic systems. OMI planned to use a random technique of mining, keeping the mining ship headed into the wind, possibly cutting fuel costs compared with a regular sweep pattern. Sedco would furnish the mining ship, the 17,000-ton *Sedco 445*, which was converted in October 1977. Dynamic position control was maintained by 11 thrusters, fore and aft. The center well was 21 meters by 11 meters, and the lifting capacity was 680 tons. Initial tests began in November 1977 with plans to mine 5,000 tons of nodules. Airlift injections were to be made at a depth of 1,500 to 2,500 meters, and submersible pumps were placed at about 900 meters. The 24-centimeter-diameter pipestring was to be 5,200 meters long. A patented Inco dredge was to be tested at 1,000 to 2,000 tons per day during a 4- to 5-month test in 1978. Scheduled completion of testing was 1979. Two separate towed mining systems were being used.[19]

Inco conducted various nodule-processing tests, with smelting to matte emerging as the preferred technique, yielding nickel, copper, cobalt, and a ferromanganese product. The reduced metals are contained in an alloy concentrate that can be processed in Inco's existing plants. Sumitomo Metal Mining Co., Ltd., an important participant in Deep Ocean Mining Co. (DOMCO), announced the start of construction of a nodule-processing plant beginning early in 1978.[20]

AMR made investigations including solvent extraction, sulfuric acid leach, and SO_2 roast-leach. The *R/V Valdivia* conducted tests of nuclear-power equipment off Hawaii in 1977.[21] In situ analysis of the mineral content of nodules on the seabed was made.

Ocean Mining Associates (OMA).—This group, as existing in 1977, was formalized in March 1977. The original consortium was formed in May 1974 and included Tenneco, Japan Manganese Nodule Development Co., Ltd., United States Steel Corp., and Union Minière S.A. The Japanese participation was replaced by Sun Co. Inc. in 1975, and Tenneco was replaced by its former subsidiary, DSV. DSV was given a service management contract and has conducted extensive ocean nodule exploration since 1962 — first as Newport News Shipbuilding & Dry Dock Co., a subsidiary of Tenneco; after 1968 as a new subsidiary, Deepsea Ventures; and most recently as DSV.

In 1969, DSV bench-tested an airlift nodule recovery system. Much of its original exploration and testing took place on the Blake Plateau in the Atlantic Ocean, off the Southeastern United States.[22] In 1970, a mining test of the airlift system was con-

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ducted there at 900 meters. Nodules were successfully brought to the surface through a 24-centimeter- diameter pipestring.

Since August 1969, DSV had conducted a number of detailed exploration cruises in the Northeast Pacific at approximately 15° N., 120° W. Based on these studies, on November 14, 1974, the company filed with the U.S. Department of State a notice of discovery, claim of exclusive mining rights, and request for diplomatic protection of investment. This mining right claim was not officially recognized by the United States or any other country, although in its official reply, the State Department recognized the rights of freedom of the high seas existing under international law.

By 1975, *R/V Prospector*, operated by DSV, had completed 40 exploratory cruises in the Pacific Ocean, with extensive seafloor photography and bottom sampling, and had recovered 300 tons of nodules.[23] Mining tests were conducted from a 98-meter, 7,500-ton converted general cargo ship, the *R/V Deepsea Miner*, which was equipped with a 6.1- by 9.1-meter center well and a 23-meter derrick.[24] As part of DSV's expanded development program, which included pilot-scale mining, the 170-meter, 26,000-ton iron ore carrier *Weser Ore* was converted in Galveston, Tex., in late 1976 and early 1977 and became *R/V Deepsea Miner II*. It is equipped with thrusters, an 8.2- by 10.2-meter center well, and a gimballed platform with 450-ton capacity.[25] A 21-meter-high geodesic dome structure provided weather protection to the 17-meter derrick.[26]

Final debugging of *R/V Deepsea Miner II* took place in February and March 1977 in preparation for test recovery of nodules from 4,600 meters at DSV's Pacific "claim."[27] The tests, covering a 6- to 8-month period, were to be of a 1/5-scale (600-ton-per-day) airlift system. Plans called for recovery of approximately 15,000 tons of nodules to feed a nodule-processing plant for test metal extraction.[28] The dredgeheads were to be lowered over the side and keelhauled under the center well for attachment to the pipestring. Some pipestring problems were encountered initially, but on the second cruise late in 1977 the test of the prototype airlift system was reportedly successful. It was the first time an airlift system had been operated at this depth.[29] The goals achieved were lowering the pipestring to 4,800 meters and demonstrating water circulation capabilities in the pipeline, and lowering the collector to the seabed to determine its ability to track the ship and pipestring. Owing to electrical problems, however, the two systems were not tested together successfully, and therefore no nodules were pumped. The test results were additionally encouraging owing to the difficult weather in which the tests were conducted. All of the tests were monitored for the DOMES project.[30]

OMA had developed three viable hydrometallurgical methods of nodule processing by 1975 through research by DSV, United States Steel, and Union Minière. DSV's process relied on hydrochloric acid leaching developed at Glouchester Point, Va. In 1968, after initial bench testing, a 1-ton-per-day pilot plant was successfully operated. The choice of the chloride process committed DSV to manganese recovery to recycle the chloride ion. Owing to the symbiotic relationship with chlorinated hydrocarbon plants, a nodule-processing plant utilizing the hydrochloric acid leach process could be located in the gulf coast region. OMA, however, may abandon the chloride process owing to high capital costs caused by environmental restrictions.[31] This would mean that the research by United States Steel and Union Minière may become more important. OMA remained interested in a 4-metal recovery, whether employing a hydrometallurgical or pyrometallurgical process. If the chloride process were, in fact, dropped, a planned processing plant could be located on the west coast or Hawaii instead of the gulf coast.

Ocean Minerals Co. (OMINCO).—The Lockheed consortium was formalized in November 1977. James G. Wenzel, Lockheed's vice president for ocean systems, was chairman and president of the venture. Lockheed was engaged as the prime contractor for OMINCO. Lockheed had sponsored ocean mining projects since early 1964 and had sought partners since 1975. In 1974, Lockheed was the main subcontractor for the technical aspects of the venture involving Summa Corp. and the *Glomar Explorer* used to recover parts of a sunken Soviet submarine. Several charters were undertaken in the early 1970's, one of which was a joint venture with the U.S. Bureau of Mines and International Minerals and Chemicals in 1971, to develop ocean-mining systems.[32] Research was directed toward nodule recovery equipment; little deep seabed exploration was conducted.

OMINCO contracted with Global Marine for use of the *Glomar Explorer* for prototype

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nodule mining tests beginning in 1978.[33] The *Glomar Explorer*, on a 13-month lease to Global Marine, had a lifting capacity nearly 18 times that of most offshore oil-drilling ships. The working payload was 4,000 tons with a 5,200-meter pipestring. The 188-meter, 63,000-ton ship had a center well measuring 61 meters long, 23 meters wide, and 20 meters deep.[34] The lift rate was about 3 centimeters per second, and it would require 3 1/2 days to deploy the pipestring to its full 5,200-meter length. Initial test operations of a 1/5- to 1/4-commercial-scale (1,000-ton-per-day) miner were planned for middle to late 1978. Previous scaled-down tests had been conducted under simulated conditions. Lockheed kept its options on airlift or hydrolift systems. Buoyant submersible lifting was ruled out.[35]

Although little information exists concerning OMINCO's nodule-processing achievements, Lockheed had verified laboratory results of metal product recovery from nodules in a mini-pilot plant operation.[36]

Continuous Line Bucket Group (CLB).—This group was the first of the nodule mine development consortia. It was initially organized in 1971 by Ocean Resources Inc. to develop a CLB mining system and did not intend to enter commercialization, although members were free to proceed with their own plans. John Mero was the project manager for the group and the leading proponent of the system.[37] The system consisted of a continuous line of buckets secured to polypropylene line which was lowered to the bottom, dragged across the seafloor dredging nodules, raised to the surface, and emptied before continuing down again. A full-scale test was conducted at a depth of 4,700 meters.[38] When first tested in 1970 using one ship, efforts were less successful owing to fouling of the up-line and down-line buckets. Other tests were conducted in 1972, 1973, and 1975. A hydrodynamic separation of the buckets has apparently worked well in tests by the Japanese.

The French CNEXO, a leader in technical developments for CLB through computer studies, bucket design, and scale-model testing, proposed a two-ship method which offered greater flexibility in controlling fouling and improved the mining pattern.[39] The two-ship method, tested by CNEXO, employed a lead ship to guide the down-line buckets and control the mining pattern and a mining vessel that hauled the line up and emptied the buckets. CLB was preparing for a test of the two-ship method in 1978,[40] utilizing 16,000 meters of 2,000-ton test polypropylene cable. The mining rate possible was 10,000 tons per day at a loop speed of 1 meter per second.[41]

Association Française pour l'Étude et la Recherche des Nodules (AFERNOD).—This French group had been conducting nodule exploration since 1970. Four original partners spent $20 million since 1970 and entered into a 3-year contract in 1974.[42] Heavy emphasis was placed on minesite delineation. The nodule mining program was formalized in mid-1977, when a fifth member, BRGM, was added to the group. CNEXO, the leader of this group, conducted its research work through contracts with French companies. Early nodule exploration from 1971 to 1974, near Tahiti, was discontinued in favor of the Clarion-Clipperton zone in the Northeast Pacific. The group developed a grid sampling system and delineated several potential minesites in the prime nodule zone.[43]

A mining system was not chosen, but three were being investigated. CNEXO participated in the 1972 CLB test and led in CLB development, especially in the two-ship format. CEA was leading the airlift system effort and developed a final design for sea trials.[44] The group was also considering a hydraulic lift system of a two-stage design in which the nodules are hydraulically lifted by a submerged pump at about a 400-meter depth where the nodules are separated and then pumped to the surface in a concentrated slurry by a second pump.

Processing research was on a bench scale. Both pyrometallurgical and hydrometallurgical processes were considered, with special attention given to sulfuric acid and ammoniacal leaching. CEA investigated the Caron laterite process (ammonia leach) and installed a nodule-processing pilot plant. Soc. le Nickel (SLN) had pyrometallurgical experience with nickel laterites.

Deep Ocean Minerals Association (DOMA).—DOMA, established in 1974, was a Japanese Government-sponsored organization comprising some 30 private Japanese companies under contract to the Metal Mining Agency of Japan, which is part of the Japanese Ministry of International Trade and Industry.[45] DOMA's surveys of the North Pacific nodule area were in conjunction with the Geological Survey of Japan (GSJ), with which it shared the survey ship *R/V Hakurei Maru*. Although

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GSJ published cruise data reports, little was known of the activities of DOMA. The Japanese Government planned to fund the construction of a second survey vessel by 1980.

Although a Japanese engineer invented the CLB system, the Japanese did not conduct much CLB development since the 1972 test.[46] DOMA was believed to be working on a hydraulic lift system. Mining test work was scheduled for completion in 1979.

Little was known of the nodule-processing plans of DOMA, although the Sumitomo group, one of the member companies, conducted smelting tests on nodule samples.

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The Mineral Industry of Afghanistan

By E. Shekarchi[1]

The status of the Afghan mineral industry during 1977 remained almost unchanged from that of 1976. The nation's major mineral production continued to be natural gas from Shibarghan Province. The value of the gross national product (GNP) increased from $2.4 billion[2] in 1976 to $2.5 billion during 1977. These increases were owing to unrecorded remittances, about $50 million brought into the country by a large number of Afghanis working abroad in Iran and other Organization of Petroleum Exporting Countries (OPEC) countries, and a substantial reexport trade with Pakistan and Iran.

A report published by the Ministry of Mines and Industries and the Geological Survey indicated a number of locations and regions where uraium had been found. The report, which was a compilation of the old findings and a new geophysical survey, recommended further detailed geophysical work to outline promising anomalies at the Jalalabad Basin, the Panjshir-Bannyan fault zone, and the Doah- Ishpushtu area.

A report by the United Nations Development Program and the Government of Afghanistan was released at the end of 1977. The report, covering 1977-82, the 6-year period that coincides with the time frame of the Afghan 7-year plan, proposed 11 projects at a cost of $44 million. Of this, only $14 million was for the mining sector.

A report prepared by Soc. Francçaise d'Eétudes et de Realisations Furoviaire (Soferail) recommended a railroad system for Afghanistan, 1,190 kilometers long and costing approximately $1.1 billion, as a part of the 7-year development plan. Construction of the railroad was to begin by the end of 1978 if the Government could obtain enough loans abroad.

Afghanistan completed 2 years of its ambitious 7-year (1977-82) economic and social development plan, which calls for public-sector expenditures for industry, irrigation, and transportation. The largest development projects in the plan were directed toward exploration and exploitation of oil and gas, development of an iron and steel industry to exploit the rich iron ore deposits, and conctruction of a copper smelter to exploit the copper reserves near Kabul. The Government experienced difficulty in attracting foreign investors to take part in these ventures, possibly because the Afghan investment law enacted in 1976 limits foreign ownership of industries to 49%.

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PRODUCTION AND TRADE

Barite production form the Sanuglan District of Meral Province increased slightly, and exploration work at Faranujal near Ghorband showed proven reserves of 1.5 million tons. Asbestos production reportedly dropped from 13,260 tons in 1976 to 4,500 tons in 1977; however, it is reported that with better transportation facilities the mine could double its production. Afghanistan led in world production of lapis lazuli in 1977 with about 8 tons, which accounted for 80% of world production. Most of the lapis lazuli, a semiprecious gem stone, was exported. The Government intensified its exploration efforts on the Hajigak iron deposits, situated in the Hindu Kush mountains northwest of Kabul. A railroad branch was scheduled to connect this deposit to the main highway system of the country. Proven reserves were reported at 2 billion tons of high-grade iron ore. Exploration for copper continued, and by yearend, 3.5 million tons of copper reserves containing 0.7% to 1.2% copper was proved.

Natural gas production during 1977 amounted to nearly 2.6 billion cubic meters, down from the peak of nearly 3.2 billion cubic meters in 1974. Natural gas production was from 33 wells in the Khawaga Gogerdak gasfield located in Shiberghan Province. Gas was extracted from the upper (1,800-meter) horizons, where recoverable reserves were placed at 23 billion cubic meters of sweet gas. Another 18 billion cubic meters of sour gas, also recoverable, was reported at the lower (2,200-meter) horizon. Gas was collected at two receiving stations and piped to a nearby drying plant. From there, about 95% was exported to the U.S.S.R. tjrpigj a 100-kilometer-long, 820-millimeter-diameter pipeline. Except for a small amount of gas consumed at the drying plant to generate electricity and produce steam, the unexported gas was transported 88 kilometers through a 320-millimeter-diameter pipeline to the Mazar-i-Sharif power and fertilizer plants. Most of the electricity from this powerplant, located within the fertilizer complx, was consumed at the site, with small amounts supplied to the towns of Mazar-i-Sharif and Balkh.

The secon major gasfield under development was Jarq-aduq, about 11 kilometers to the southwest in Shiberghan Province. Production was to begin in 3 or 4 years upon completion of a desulfurization plant that was under construction during 1977. A total of 44 production wells have been planned for this field, along with two pipelines a 30-kilometer-long, 720-millimeter-diameter line for transporting desulfurized gas for export and an 11-kilometer-long, 159-millimeter diameter line to Shiberghan for industrial and consumer uses. The entire project was on a turnkey basis provided by the Soviet firms Technoexport and Mitprom Export.

Recoverable gas reserves of 35 billion cubic meters in the Juma structure northwest of Shiberghan and 12 billion cubic meters in the Atimtag structure near Khawaja were also established. A total of 77 structures were identified by the end of 1977, of which 34 were tested by one or more wells.

Petroleum was discovered in Afghanistan in 1956 at Angut, but it was not until 1970 that the potential of this field was known. Subsequently, in the same general area, three other oil structure— Agdarya, Bazarkami, and Oashg-oir, with total recoverable reserves of about 13 million tons—have been identified. Three discovery wells and one dry well had been drilled by the end of 1977, and two more were underway.

As a result of additional petroleum discoveries, the Government, for the second time, revised upward its refinery requirements to 500,000 tons. In 1977, Afghanistan imported 245,000 tons of petroleum products, vaued at $30 million, compared with 241,000 tons valued at $27 million in 1976. The U.S.S.R. and Iran were its chief suppliers both years.

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[1]Supervisory physical scientist, Branch of Foreign Data.
[2]Where necessary, values have been converted from afghanis (Afs) to U.S. dollars at the rate of Af45 = US$1.00.

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Table 1.—Afghanistan: Production of mineral commodities

(Metric tons, unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
Asbestos	--	13,260	[e]4,500
Barite	5,200	5,316	[e]5,400
Cement, hydraulic	140,000	[e]167,000	136,201
Coal, bituminous	160,000	164,131	182,000
Gas, natural:			
Gross ---- million cubic feet	105,944	[e]96,000	[e]90,000
Marketed ---- do	98,881	89,805	[e]84,000
Gem stones: Lapis lazuli ---- kilograms	[r]8,108	7,406	6,310
Natural gas liquids ---- thousand 42-gallon barrels	[e]15	9	[e]10
Salt, rock	60,000	69,583	77,684
Talc	6,300	8,685	[e]9,000

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the commodities listed, a variety of crude construction materials (clays, stone, and sand and gravel) presumably were also produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

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The Mineral Industry of Albania

By George Rabchevsky[1]

In 1977, Albania continued its position as one of the world's largest producers of chromite. According to their claims, Albania also ranks among the principal countries of Europe in reserves of nickel and iron-nickel ores. Chrome ore is Albania's most important export commodity.[2] The country is self-sufficient in energy and exports oil, coal, and electrical energy. Endemic to Albania are vast deposits of natural bitumen, which it utilizes domestically and exports to Yugoslavia. Almost all of the country's iron ore is smelted domestically and many other commodities are retained for local utilization as part of Albania's principle of self-reliance and self-sufficiency.

Even though Albania's fifth 5-year plan (1971-75) fell short of many of its objectives, the current sixth 5-year plan (1976-80) seems to be progressing as planned during its first 2 years. In 1977, however, Chinese-Albanian relations worsened. Because Mainland China has been a principal trading partner of Albania since 1970, and a joint long-term trade and economic agreement granted Albania interest-free loans and technical assistance, the worsening relations, therefore, will undoubtedly affect Albania's domestic and foreign economy in the immediate future.

Government Policies and Programs.—The Albanian sixth 5-year plan envisages a rise of 41% to 44% in industrial production, primarily in the mining industry sector. Priority in 1977 in the country's industrial development was given to the mining and mineral processing industries. The Albanian national plan and budget for 1978 includes a provision for the construction of iron-nickel mines in Prrenjas and Guri-i-Kuq, and in particular to several chromite and copper mines and dressing plants in the districts of Dibër, Mirditë, Korcë, and Kukës. Work will also commence on the construction of another powerplant on the Drin River and the Kaman hydroelectric plant.[3] It is expected that coal, oil and gas, steel, and electric production will also be increased in 1978. Overall industrial production in Albania is scheduled to increase by 8.5% in 1978, over the 1977 target. Because of some failures in 1977, however, the fourth plenum of the Albanian Workers Party Central Committee, which discussed the fulfillment of the 1977 plan and the tasks for the 1978 plan, called not only for the fulfillment of the 1978 plan but also for the compensation of a considerable portion of the deficits created in certain sectors in the previous 2 years. The national income is to increase 12%, a 28% rise in farm production and a 10% increase in exports are also planned for 1978. The volume of capital investment and construction is forecast to increase by 18%, which will include 37 new industrial construction-assembly projects. Work will be continued on the three turbines at Fierzë hydroelectric power station, on the oil refinery and processing plant in Ballësh, and on the Prrenjas-Guri-i-Kuq railway (linking the two iron-nickel mines), and the Fier-Vlora railway. The 1978 state budget set the incomes at lek7,800 million and expenditures at lek7,700 million.[4]

The immediate goal of Albanian geologists is the discovery of new raw materials, such as coking coal, nickel-free iron, phosphates, high-quality asbestos, and many other minerals, more than 40 of which are known to exist in Albania. Over a dozen new mines are planned to be developed during the current 5-year plan and production of chromium ore is to be increased by

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47%, that of copper ore by 55%, iron-nickel by three times, and coal by two times in relation to the past 5-year plan.[5]

In the current 5-year plan, the Albanian geological survey planned for 66% more drilling, 23% more mine workings, and 26% more of other related work. The economic growth of Albania is closely linked with the development of its mineral resources. The mineral industry is centrally controlled and headed by the Ministry of Heavy Industry and Mining, production schedules and targets are prescribed by the 5-year and annual plans.

PRODUCTION

According to Albanian sources, the 1977 production plan for chromite was exceeded and the plans for copper, iron-nickel ore, and other minerals were fulfilled. The coke and chemical plant of the Elbasan metallurgical complex began production of sulfur in 1977, and the chemical industry in general developed rapidly, using many locally available minerals. Plants were under construction to manufacture fertilizers and pesticides, caustic soda and soda ash, sulfuric acid, and oxygen. Some type of pyrometallurgical plant was also supposedly under construction in 1977.[6]

According to Thanas Dede, Director of Heavy Industry of the Ministry of Heavy Industry and Mining, the plans for the first 2 years of the sixth 5-year plan were fulfilled and surpassed. Special mention was made of the chromite mines in Bulgiza and Batra, the copper mines in Kurbnesh, and the mine construction enterprise. Some mines, however, fell short of the expected plan, such as the coal mines in Tirana and Memaliaj and the chromite and copper mines of Kukës and Korcë. Those mines were the least productive in spite of the repeated recommendations by Government directives to improve their work. The Tirana coal mines were the least progressive in the fulfillment of their plan, with the worst results being in the Mushqeta mine. Lack of personnel and experienced specialists were reportedly the cause of this deficiency, as was the inadequate supply of timber for mine support. As an example of efficient mining practice in areas where timber is scarce, the excavation work in the unstable underground coal formations at Valias was commended, as was work at Gurakup and drilling at Prrenjas and Kalimash. The chromite mines in the Kukës district (Gjegjan, Kalimash, and Thirre) ended the 1977 year with a substantial deficiency, especially in the ore drilling program. Although the industrial quotas have been filled, the mine management has been criticized for not worrying about other production indicators, such as more efficient monitoring of work and the discouragement of the liberal work attitude. Accordingly, the executive committees of the people's councils of Kukës and Mirditë districts (copper and chromite mines) were advised to take measures to supplement the existing labor force, especially in the chromite mines of Kalimash and Thirre. The iron-nickel mine of Cervenaka has, in general, overfulfilled its plan. This mine did not fulfill its 1976 plan and mine managers were accused of remaining indifferent and inactive in their corrective measures. An urgent analysis was proposed for the solution of the materials supply in that district and of the mine management in general. The 1 and 2 coal mines of the Mborje-Drenova district were commended for completing their work and in the overfulfillment of the plan and were cited as an example to the coal mines of the Kolonje district. The Krosnisht, and especially the Bezhan mines of that district, did not meet the plan and the leadership of the Mborje-Drenova mine was instructed to supply the Bezhan mine with mature and experienced miners and specialists for more efficient running of the new mine. Overall production deficiencies and management weaknesses were blamed on the poor performance by the Ministry of Heavy Industry and Mining itself, whose responsibility it was to exert greater control and supervision in the fulfillment of the projected plans.[7]

Rahman Hanku, Minister of the Construction Ministry, reported that in 1977 the industry completed construction and installation of many projects, among them the copper plant in Fushe-Arrez, the quartzite plant in Laç, the Enver machine plant, the iron-nickel mine in Prrenjas, and will soon put into operation the first unit of the hydroelectric plant in Fierzë. Some of those projects, however, have not been totally completed and will be continued in 1978.[8]

The oil and gas industry fulfilled its 1977 plan with the discovery of new reserves and the drilling of a number of oil wells. The Ministry of Heavy Industry and Mining reported, however, that during 1977 many

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drilling rigs, did not operate at all; furthermore, a number of rigs were left idle due to frequent breakdowns, workers' absenteeism, and poor performance. In 1977, 21% of the workers failed to fulfill their work norms, while 30% exceeded them by over 10%.[9]

Available information on Albania's mineral industry is scant and mostly inferential. Official Albanian production and trade statistics are not available and because entry into the country is strictly controlled, accounts by unofficial and foreign sources are poor and incomplete. Statistical information on Albania has been published by the Federal Bureau of Mines since 1963, and probably the first known account of chrome mining in Albania was published in 1970.[10] Official plans and plan fulfillments, however, are available from Albanian newspapers and media, even though they contain more rhetoric than statistical and factual data. All of the published information is confined to general statements, with percentage figures referring to the degree national plans have been executed. Most of the production data and trade statistics in this report are assimilated from various sources and are compiled from returns, when available, of trading partner countries.

Table 1.—Albania: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Chromium, chromite, gross weight thousand tons	779	830	880
Copper:			
Mine output, metal content	[r]9,000	10,000	9,000
Smelter, primary and secondary	[r]8,500	9,000	9,000
Refined, primary and secondary	6,000	7,000	7,000
Iron and steel:			
Iron ore, nickeliferous, gross weight	650,000	700,000	760,000
Steel semimanufactures[e]	38,000	40,000	40,000
Nickel, mine output, metal content	6,500	7,000	7,500
NONMETALS			
Cement, hydraulic thousand tons	650	700	750
Fertilizer materials, manufactured:			
Nitrogenous: Gross weight[e] do	210	250	260
Phosphatic:			
Gross weight[e] do	[r]75	70	65
Phosphorus pentoxide content[e] do	25	22	21
Salt[e]	50,000	50,000	50,000
Sodium compounds, n.e.s.:			
Caustic soda	18,000	NA	NA
Sodium carbonate, calcined (soda ash)[e]	21,000	21,000	23,000
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural[e 2] thousand tons	1,100	1,350	1,500
Coal, lignite[e] do	[r]900	975	1,000
Gas, natural, gross production[e 3] million cubic feet	10,590	12,370	12,370
Petroleum:			
Crude oil:			
As reported million tons	[r]2,250	1,800	1,900
Converted thousand 42-gallon barrels	15,346	12,410	12,676
Refinery products:[4]			
Gasoline do	850	1,360	1,488
Kerosine do	310	388	465
Distillate fuel oil do	1,492	1,865	2,238
Residual fuel oil do	2,331	2,850	2,330
Lubricants do	70	84	84
Asphalt and bitumen do	(3)	(3)	(3)
Other do	1,947	2,100	2,400
Total[5] do	7,000	8,647	9,005

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, a variety of crude construction materials (common clay, sand and gravel, and stone) is undoubtedly produced, but output is not reported quantitatively and available information is inadequate to make reliable estimates of output levels. Moreover, metallic nickel production reportedly began in 1978, but no data on the level of production is available.

[2]Data on petroleum refinery-produced asphalt and bitumen are included with natural asphalt and bitumen.

[3]Separate data on marketable production are not available, but gross and marketed output are regarded as nearly equal.

[4]Estimates based on estimated tonnages published by the United Nations in World Energy Supplies 1972-76. Statistical Papers, Series J, No. 21, New York, 1978, 233 pp.

[5]Partial figure, sum of listed products only, no estimates have been made for other products produced.

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TRADE

In 1977, Albania continued to practice its policy of self-reliance and economic self-sufficiency. Albanian relations with Mainland China, its principal trading partner, worsened in 1977, and Albania began to look into expanding its exports elsewhere to pay for increasing imports. According to various sources, in 1977 Albania had economic and diplomatic relationship with about 80 countries.[11]

Minerals and related products, as in previous years, accounted for most (75%) of Albania's exports in 1977, while it imported heavy machinery, technology, and consumer goods.

Chromite continued to be Albania's most important export commodity. Of the estimated 880,000 tons of chromite preduced in 1977, 720,000 tons or 82% was exported. Other important Albanian exports included natural bitumen, oil, iron-nickel ore, copper, and hydroelectric power. All of the exported hydroelectric power was sent to northern Greece and Yugoslavia.

In 1977, in addition to the consumer goods and heavy machinery, Albania continued to import pig iron and steel products, coke, and fertilizer materials. In general, however, the domestic supply of raw materials is sufficient for the country's present low-level industrial development and, therefore, the requirements for imports of raw materials are kept low. China was not only Albania's trading partner in 1977, as in previous years, but also was its technical ally, as technical and economic assistance of China dominated the Albanian economy. Both, the Elbasan ferrous metallurgical complex, Albania's largest, and the oil refinery at Ballesh, the second largest plant, were built with Chinese assistance.

In 1977, however, Chinese-Albanian relations began to deteriorate, as Albania criticized certain aspects of Chinese foreign policy after Mao Tse Tung's death. Long-term trade and economic agreements between the two countries resulted in Chinese participation in the industrialization of Albania, the latter becoming China's only ally. By 1976, 54% of Albanian chrome ore, for example, was shipped to China, which accounted for nearly the total Chinese chrome requirements.

Albanians are exploring trade options with other Western nations, especially Italy, Greece, France, the Federal Republic of Germany, Yugoslavia, and Spain. Prior to 1974, the United States was importing Albanian ore reexported by Yugoslavia, and more recently has been purchasing Albanian chrome (25,000 tons in 1977) through brokers. Total U.S. imports from Albania were valued at US$2.5 million in 1976 and US$3.4 million in 1977, and are expected to rise in 1978. Albania has bought from the United States videotape equipment and cattle hides. The 1976-77 U.S. trade with Albania is summarized in the following table:

Commodity	Albanian exports to U.S. (million US dollars)		Albanian imports from U.S. (million US dollars)	
	1976	1977	1976	1977
Crude materials, inedible	$2.58	$3.33	$0.42	$0.27
Mineral fuels, lubricants	--	--	--	1.81
Chemicals	.01	.02	--	.03
Manufactured goods	--	--	.08	--
Machinery and transport	--	.04	--	--
Miscellaneous manufactured articles	--	.01	.58	.07
Total	2.54	3.40	1.08	2.18

A trade agreement between Albania and the Democratic Republic of Germany was signed in 1977. Albanian imports are to consist mainly of machinery and equipment for agriculture and shipbuilding, chemical products, and scientific instruments. Albania agreed to export chromite, copper cable, agricultural products, and consumer goods to the Democratic Republic of Germany. Under a similar agreement, Albania will export chrome, iron ore, bitumen, and agricultural products to Poland in exchange for machinery and equipment, metallurgical goods, and chemicals.

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Table 2.—Albania: Exports of selected mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Chromite ---- thousand tons	355	218	Yugoslavia 71; Poland 51; Italy 80; Czechoslovakia 24.
Copper, metal, unwrought	950	947	Italy 548; Austria 399.
Iron and steel, plates and sheets	NA	21	All to Italy.
Silver, waste and sweepings ---- value, thousands	$214	$227	Do.
Other:			
Alloys, including metal ores	--	6,836	All to Hungary.
NONMETALS			
Cement	26,531	11,608	All to Yugoslavia.
Clay and clay products, nonrefractory	16,490	6,156	Do.
Fertilizer, manufactured, nitrogenous	NA	782	All to Italy.
Sodium and potassium compounds: Soda ash	1,166	3,854	Italy 2,397; Greece 1,457.
Stone and sand and gravel	--	1,049	All to Poland.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	2,029	794	All to Yugoslavia.
Petroleum:			
Refinery products:			
Gasoline ---- do	87	81	All to Italy.
Distillate fuel oil ---- do	36	15	All to Hungary.
Bitumen ---- do	1,566	1,124	Italy 456; Greece 231; Hungary 207.
Unspecified ---- do	931	980	All to Poland.

NA Not available.

[1]Compiled from the trade returns of the trading partner countries as reported by the Statistical Office of the United Nations, Supplement of the World Trade Annual, Volume 1, Walker and Co., New York 1978, pp. 53-99, and in the 1976 official trade statistics of Czechoslovakia, Hungary, and Poland.

Table 3.—Albania: Imports of selected mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum metal including alloys, all forms	1,116	1,653	Hungary 858; Greece 562; West Germany 233.
Copper metal including alloys, all forms	133	450	West Germany 313; Italy 137.
Iron and steel:			
Pig iron including cast iron and ferroalloys	3,812	620	All from Portugal.
Semimanufactures:			
Bars, rods, angles, shapes, sections	28,208	30,116	Poland 14,778; Greece 10,000.
Universals, plates, sheets	23,180	[2]13,137	Greece 3,845; Italy 3,455; Hungary 2,727.
Wire	191	[2]113	Greece 72; West Germany 30.
Tubes, pipes, fittings	9,948	3,718	Japan 1,573; Italy 1,271.
Hoop and strip	684	--	--
Rails and accessories	1,291	173	All from Japan.
Manganese, oxides	--	45	Do.
Silver, unwrought ---- value, thousands	--	$103	All from Yugoslavia.
Zinc metal including alloys, all forms	168	26	All from West Germany.
NONMETALS			
Asbestos, crude	846	1,371	All from Yugoslavia.
Cement, hydraulic	1,292	1,188	Greece 958; Hungary 230.
Clay and clay products, refractory	2,587	1,937	Poland 1,255; Yugoslavia 634.
Fertilizer, manufactured, potassic	5,795	7,400	West Germany 4,800; Italy 2,600.
Sulfur:			
Elemental	1,132	415	All from Greece.
Sulfuric acid	4,268	3,830	Do.
Talc	--	94	All from Italy.
MINERAL FUELS AND RELATED MATERIALS			
Coke ---- thousand tons	15	12	All from Poland.
Petroleum, refinery products:			
Gasoline ---- 42-gallon barrels	--	1,700	All from Greece.
Distillate fuel oil ---- do	--	46,819	All from Italy.
Residual fuel oil ---- do	3,683	14,346	Do.
Lubricants ---- do	10,255	6,664	Do.
Other:			
Mineral jelly and wax ---- do	--	1,401	All from Yugoslavia.
Coal tar	200	200	All from Italy.

[1]Compiled from the trade returns of the leading partner countries as reported by the Statistical Office of the United Nations, in the 1976 Supplement to the World Trade Annual, Volume 1, Walker and Co., New York 1978, pp. 100-102, and in the official Trade Statistics of Hungary and Poland.

[2]Partial figure, tonnage not available for all sources.

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COMMODITY REVIEW

METALS

Chromite.—Albania is one of the world's largest chrome ore producers and claims that it is first in the production of chromite per capita and second in the production of metallurgical chromite.[12] In 1977, the country produced 880,000 metric tons of chromite, which is a 6% increase over the 1976 production. The current 5-year plan calls for the production of 1,250,000 tons of chromite by 1980, with 990,000 tons planned for 1978, and 1,110 tons planned for 1979. The trend of the Albanian current 5-year chromite plan is summarized in the following table, in metric tons:

	Actual		Planned		
	1976	1977	1978	1979	1980
Chromite production (tons)	830,000	888,000	990,000	1,110,000	1,250,000
Chromite exports	690,000	720,000	800,000	900,000	1,000
U.S. imports	18,000	25,000	43,000	--	--

The Albanian chrome ore is suitable both for metallurgical and refractory applications. The average Cr_2O_3 content is 43% and the ratio of Cr_2O_3:FeO=3. The guaranteed Cr_2O_3 content is 42% and pricing is usually based on 44% Cr_2O_3 with maximum 10.5% SiO_2. The average grade (Cr_2O_3 content) of Albanian exported chrome ore has been increasing steadily from 22.8% in 1960, to 41% to 46% in 1974, when about 25% of Albanian chrome ore was processed. Mineralimpeks, Albania's state-controlled export agency, markets two grades of chrome ore: (1) a medium-grade, lumpy ore at 42% to 44% Cr_2O_3 content, and (2) a high-grade concentrate at 48% to 50% Cr_2O_3. Chrome ore exported to Yugoslavia is of two grades: (1) A-I and A-II is from 45% to 48% (and over) Cr_2O_3, and (2) A-III is 45% Cr_2O_3 and less. In 1977, Albania exported 27,249 tons of chrome ore to Japan.[13]

The Todo Manco mine at Martenesh is the country's largest chromium producing mine and is able to process 200,000 tons per year of concentrates. A similar beneficiation plant is being installed at Bulgiza and is intended for production of concentrates with over 50% Cr_2O_3. Another concentrator, scheduled to become operational by 1980, is under construction at Kam-Kalimash.

The Albanian chrome deposits occur in the Lower Jurassic beds (harzburgites), the deformed Balkan-Asia Minor ultramafic province, in the Dinaride extension of the Alpine mountain chain. The ore occurs as podiform deposits, similar to those of Turkey, containing tens of thousands to several hundred thousand tons. These lenses are found at shallow depths and are mined partly underground and partly by open cast methods.

Albania's total chrome ore reserves have been estimated at 21.5 million tons. Of this total, 6.5 million tons are measured and indicated reserves and 15 million tons are potential reserves. These reserves are expected to last for another 20 years.

Copper.—Estimated 1977 production of copper ore remained as in 1976, at 600,000 tons. The metal content of mine copper and smelter output were 9,000 tons each. Reportedly, the blister copper production plan was exceeded by 6% in the first 9 months of 1977. The 1978 output is expected to increase for smelter output by approximately 6%. The 1980 copper ore production goal is set to be 55% greater than in 1975.

Almost half of Albania's copper is produced in the Mirditë district, which includes mines, concentrators, and smelters. The mining industry specifically accounts for more than 90% of the district's industrial production. Pyrite is also mined as a byproduct of copper in the Mirditë district.

Albania has three copper smelting plants, the Laç in the Kruja district north of Tirana, will be the largest, once completed in 1979-80. The two other smelting plants are located at Kurbnesh (Mirditë district) and Zall-Rec in the Kukës district. In 1977, a copper concentrator was under construction in Fushe Arrez in the Pukë district, to be operational in 1978.

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Albanian copper ore reserves are estimated at 50 million tons. Most of the ore is low-grade (sulfide), located in the northern Mirditë district and some in Kruja, Kukës, Pukë, and Shkodër districts. The average recoverable copper content of the ore is 1.9% copper, but the presently mined ore averages 3% copper.

Iron Ore, Nickeliferous.—The 1977 production of nickeliferous iron ore was estimated at 760,000 tons, a 9% increase over that of 1976. Reportedly, the entire production capacity was utilized domestically at the Elbasan Metallurgical Combine. The country's largest industrial project, the 800,000-ton metallurgical complex, is scheduled to be fully operational for the production of nickel, steel, and cobalt in 1978. No new deposits of iron ore were discovered, nor were any iron ore mines opened in 1977. Work, however, continued in 1977 on the ferrochrome plant in Burrel and the iron-nickel mine and beneficiation plant at Guri-i-Kuq. The total reserves of ferronickel ore remain as estimated previously at 20 million tons, containing 51% iron, 1% to 6% nickel, and 0.06% cobalt.

The target production of nickeliferous iron ore planned for 1980 is 2,145,000 tons, all designed for domestic smelting at the Elbasan steelworks.

The nickeliferous iron ore mines in operation in 1977 or in progress of development, included the following: Bushtrice; Burrell (Mat district), including a beneficiation plant to be commissioned in 1979; Cervenaka; Guri-i-Kuq (Pogradec district); Korcë; Librazhjd, Mamez; Pishkash (Lake Ohrid); and Pogradec (Pogradec district). Deposits of nickeliferous ore also are found at Kukës, together with chromite and copper occurrences.

Iron and Steel.—In 1977, the Elbasan Metallurgical Complex was still the largest project in Albania. The equipment and construction supervision were continued to be supplied by China. The complex is designed to produce pig iron, high-strength steels, and various rolled and laminated products. The complex produced stainless steel for the first time in 1977. Reportedly, 23 types of steel have now been produced.[14] During the last 9 months of 1977, the Elbasan complex produced 6.5% of rolled steel above plan. Equipment and machinery parts are also manufactured, as are many other products. The third electric smelting furnace is to be added to the combine in 1978, and a new concentrator will supply the complex with nickeliferous iron ore from the mines at Guri-i-Kuq and Prrenjas.

NONMETALS

Cement.—The 1977 estimated production of cement was 750,000 tons, while the estimated annual kiln capacity was at 800,000 tons. The 1978 production is set at 900,000 with a corresponding increase in kiln capacity. In 1977, Albania imported 20,000 tons of cement and exported 80,000 tons, the total approximate consumption was 690,000 tons.[15] Production in 1980 is to increase 55% compared with 1975.

Albania has five cement plants, all belonging to the State Cement Co. located at Elbasan, Fusë-Krujë, Shkodër, Tirana, and Vlora. The plants extend along Albania's west coast from north to south.

Fertilizer Materials.—Estimated production of nitrogenous fertilizers in 1977 was 260,000 tons (36,000 tons nitrogen content), and the estimated production of phosphatic fertilizer was 65,000 tons (21,000 tons P_2O_5 content). Planned production for the nitrogenous fertilizers is set at 400,000 tons for 1980. The production of nitrogenous fertilizer has increased steadily since 1970 when it was 6,000 tons. The output of phosphatic fertilizers, on the other hand, has remained relatively stable. Most of Albania's raw materials for fertilizer production are imported. Phosphatic fertilizers are produced from phosphate imported from North Africa and potash is imported from Italy (approximately 2,000 tons per year, K_2O content) for the manufacture of potassic compounds. In 1977, Albania imported a total of 81,000 tons of phosphate rock, mostly from Egypt and Syria (66,000 tons), some from Morocco (7,000 tons), and Algeria (8,000 tons).[16]

The Albanian chemical industry has been developing since 1960, and now supplies all of its domestic needs for nitrogenous and phosphatic fertilizers including sulfuric acid (1977 consumption of sulfur was 2,000 tons) and caustic and calcined soda. According to the 5-year plan, investments in the chemical industry will be 51% higher than in the 1971-75 period and will constitute more than 53% of all industrial investments. Albania has two plants for the production of nitrogenous and phosphatic fertilizers and a limited quantity of phosphate rock deposits. One nitrogenous fertilizer plant is located at Fieri (Fieri district). The construction since 1975 of a urea plant at Fieri is expected to double Albania's production of nitrogenous fertilizer. The plant was expected to become operational in 1976 or

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1977. An ammonia plant is also located at Fieri, with an estimated annual capacity of 50,000 tons. Another ammonium nitrate plant was supposedly constructed at Laç.

Production of phosphatic fertilizers is centered at Laç (Kruje district), manufacturing granulated and powdered superphosphate. Albania plans to process its nonphosphatic ore at Laç for the production of phosphoric acid and triple superphosphate. Reportedly, several sedimentary phosphate rock deposits, containing 7% to 18% P_2O_5, occur in the Cretaceous Formations near Nivice and Fushe-Bardhe, Sarandi district in southern Albania.

MINERAL FUELS

Albania is self-sufficient in energy and even exports oil, electrical energy, and perhaps some coal. As in other centrally planned economy countries, measures were underway in 1977 for the conservation of energy and the promotion of coal utilization in lieu of oil and gas. The year 1977 was an especially dry year and strict energy conservation measures were in force for the utilization of hydroelectric power. This especially effected major factories, such as the Elbasan Metallurgical Complex, the polyvinyl chloride factory in Vlora, and the nitrogen and urea plant in Fieri, which together consume over 25% of the total electrical energy requirements. Plans for 1978, however, call for the generation of 34% more total electric energy. In addition to the 15 or so hydroelectric powerplants, there are also at least 10 thermoelectric powerplants fueled by oil, gas, and coal, located at Cerrik, Fieri, Fierzë, Korcë, Laç, Maliq, Salite e Malit, Stalin City, Tirana, and Vlora.[17]

The production of primary energy in Albania in 1977 was slightly higher than in the previous year, reaching 4.18 million tons standard coal equivalent (SCE). Exports and imports of primary energy remained unchanged from 1976, at 1.36 million and 20,000 tons SCE respectively. Albania's consumption of primary energy in 1977 showed only a slight (1%) increase. Petroleum accounted for 52% of the total Albanian energy consumption in 1977, coal and lignite supplied 25%, natural gas 17%, and hydroelectricity 6%. Total primary energy balances for Albania in 1976-77 are shown in table 4.

Table 4.—Albania: Total primary energy balance for 1976 and 1977

(Million tons of standard coal equivalent[1])

Year	Total primary energy	Coal (lignite, anthracite, bituminous) coke	Crude oil and petroleum products	Natural and associated gas	Hydropower
1976:[2]					
Production	4.14	0.68	2.79	0.47	0.20
Imports	.02	.02	--	--	--
Exports	1.36	--	1.31	--	.05
Apparent consumption	2.80	.70	1.48	.47	.15
1977:[2]					
Production	4.18	.70	2.79	.47	.22
Imports	.02	.02	--	--	--
Exports	1.36	--	1.31	--	.05
Apparent consumption	2.84	.72	1.48	.47	.17

[1]1 ton of standard coal equivalent (SCE)=7,000,000 kilocalories. Conversion factors used are lignite, 0.7; crude oil, 1.47; natural gas, 1.33 (per 1,000 cubic meters); hydroelectric power, 0.125 (per 1,000 kilowatt-hours).
[2]Data obtained from various Albanian sources and estimates.

Source: United Nations. World Energy Supplies. Statistical Papers, Series J, No. 18, 1975.

Coal.—Lignite is the major type of coal mined in Albania and the 1977 estimated production was 1,000,000 tons. Some subbituminous coal is mined but Albania has no high-quality anthracite or bituminous coal. A small quantity of lignite and coke is also exported, mostly to Yugoslavia. The 1980 planned production is 1,800,000 tons and at that time about 60% of the domestic lignite will be beneficiated. Much of Albania's metallurgical coal is, however, imported. The Elbasan Metallurgical Complex, for example, utilizes up to 15% of noncoking coal from the Memaliaj deposit, while the remaining 85% is imported. Reportedly, new coke oven facilities were put into operation in 1977 at the coking plant of the Elbasan complex. They are designed to produce coke byproducts such as tar, sulfur, and ammonium sulfate. Most of Albania's

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coal does not coke directly, thus necessitating import of metallurgical coal. Most of the coal has also a high ash and sulfur content, except perhaps that from the Alarupi and Bezhani mines in the southeast.[18]

Albanian coalfields may be grouped into four general geographical areas, three of them generally extending in a southeast-northwest line from Korcë to Durres, with a fourth located in the south at Memaliaj. Two of the fields, however, lie outside of this trend, one in the east in the Pogradec district (Alarupi and Cervenake mines), and the other in the Lushnjë district in the west, southwest of the Elbasan district.

Natural Gas.—Estimated production of natural gas in 1977 remained unchanged from 1976, at 12,370 million cubic feet. Although Albania is self-sufficient in gas, it planned to increase the gas output in the current 5-year plan to 15,715 million cubic feet in 1980. Total Albanian gas reserves are estimated at about 8 trillion cubic feet. About 35% of the nations total area (mostly southeast) is considered promising for oil and gas. Recent gas discoveries, for example, were reported in the Lushnjë district, at Diviakë and Budulinë. Gas also occurs at Marineze, in the Fieri district, just south of the Lushnjë district. Domestically natural gas is used in the petrochemical industry, fertilizer plants, in thermal power generation, and by the domestic sector.

Petroleum.—Albania's 1977 crude oil production stabilized at about the 1976 level, when it turned sharply downward from 1975. Albania continued to import petroleum products but also exported some in addition to the crude oil. Albania's last 5-year plan called for the production of 19 million barrels per year by 1975 and hoped to increase crude production by 11% during the current 5-year plan ending in 1980, primarily for export purposes.

Reportedly, in spite of the Albanian-Chinese rift, the construction of the oil refinery at Ballësh near Vlorë (Vlorë district) continued on schedule. By the end of the current 5-year plan period, the Albanian oilfields and refineries should be connected by an oil pipeline system, terminating at the Vlorë seaport. The new refinery at Ballësh, the second largest investment project in Albania after the Elbasan Metallurgical Complex, is rated at 1 million tons annual (20,000 barrels per day) capacity. In general, Albania's refinery capacity (2 million tons annually), appears more than adequate to meet domestic needs. Older installations are located near the Stalin oilfield (0.5 million tons), the City of Cerrik (0.5 million tons), and at Fieri (1.0 million tons).

Albanian oilfields ore concentrated in the southwestern part of the country, in three areas: The Stalin, the Marineze, and the Patos fields. A bitumen occurrence is also located just south of Patos, in the Selenice area. Reportedly, a total of eight oil- and gasfields are known to exist in Albania. The offshore Adriatic shelf is also regarded as having good hydrocarbon prospects, as is the Vlore district. The Marineze field, discovered in 1957 by Russians, is believed to be the largest Albanian oil- and gasfield. It produces light oil from six stratigraphic zones to a depth of 1,400 meters. Reportedly, none of Albania's known oil and gas deposits is deeper than 1,700 meters. The Stalin oilfield (previously known as Kucebo), found by Italians in 1936 and Albania's oldest producing field, and the Patos field, onstream since 1939, are nearing depletion. Both fields provide heavy oil.[19]

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[1]Physical scientist, Branch of Foreign Data.
[2]Rruga e Partise, Tirana. Dec. 1977, pp. 17-25.
Albania Today, Tirana. No. 1 (33), 1978.
Business Week, New York. Feb. 13, 1978, pp. 45-46.
[3]First work cited in footnote 2.
[4]Where necessary, values have been converted from Albania lek to U.S. dollars at the rate of lek1 = US$0.255.
[5]First work cited in footnote 2.
Mining Journal, London. Oct. 28, 1977.
[6]Mining Annual Review, London. 1978, p. 591.
[7]Zeri i Popullit, Tirana. July 4, 1978, p. 3.
First work cited in footnote 2.
[8]First work cited in footnote 2.
[9]Zeri i Popullit, Tirana. Dec. 13, 1977, p. 3.
Rruga e Partise, Tirana. No. 8, August 1978, pp. 28-38.
[10]Metal Bulletin, London. Mar. 13, 1970.
[11]Probleme Ekonomike, Tirana. No. 3, July-September 1977. pp. 55-62.
[12]Second work cited in footnote 2.
[13]The TEX Report Co., Ltd., Tokyo. 1978, pp. 125-127.
[14]Zeri i Popullit, Tirana. Dec. 3, 1977, p. 1.
[15]CEMBUREAU, The European Cement Association, Paris. 1977, pp. 177-178.
[16]The British Sulphur Corp., Ltd., London. 1977, p. 15.
[17]Zeri i Popullit, Tirana. Mar. 7, 1978, p. 3.
[18]Zeri i Popullit, Tirana. Jan. 7, 1978, p. 3.
[19]International Petroleum Encyclopedia, Tulsa. 1978, pp. 166-167.

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The Mineral Industry of Algeria

By David E. Morse[1]

Algeria remained one of Africa's major producers of petroleum and natural gas, cement, mercury, and barite. Production of copper, lead and zinc concentrates, phosphate rock, iron ore, and clay minerals was modest by world standards. The State-owned Société Nationale de Recherches et d' Exploitations Minières (SONAREM) carried out the marketing, exploration, production and processing of mineral commodities. Oil and natural gas activities were dominated by the State-owned Société Nationale pour la Recherche, la Production, le Transport, la Transformation et la Commercialisation des Hydocarbures (SONATRACH). SONAREM conducted investigations in northern Algeria particularly on nonmetallic industrial minerals and increased efforts to evaluate metallic ore deposits of copper, lead, mercury, and zinc. SONAREM also conducted field exploration in the remote Hoggar Mountains of southern Algeria. Although SONATRACH continued petroleum exploration and development, its major effort was geared toward developing Algeria's prodigious natural gas reserves.

The Algerian economy continued its strong growth in 1977, with the real gross domestic product (GDP) increasing 8.8%. The hydrocarbon sector retained its position as the largest contributor to the GDP but grew at a rate of 7% less than the economy as a whole. The mining sector's contribution to the GDP remained slight and did not grow during the year.

During 1977, Algeria's state corporations budgeted $1.2 billion[2] for investments in the petroleum and natural gas industries, $500 million for the steel industry, $380 million in the construction materials industry, and $340 million in chemical industries.

In 1977, Société Nationale Algerienne de l'Electricité et du Gaz (SONELGAZ) and Impiante e Nucleari AMN of Genoa, Italy, signed a contract for the construction of a gas-fired powerplant on the Mediterranean coast east of Arzew. The plant was to have three 168-megawatt generators and be in full operation in 1982. During 1977, construction was underway on five electric powerplants that would bring Algeria's generation capacity to 1,840 megawatts. SONEGAZ also planned to build a 600-megawatt powerplant near M'Sala to furnish power for Algeria's first aluminum smelter.

PRODUCTION

Mineral production in Algeria exhibited many minor changes in 1977, but the overall results were similar to those of the preceding few years. Output of crude oil, natural gas, iron ore, phosphate rock, and cement increased substantially compared with that of 1976. Barite, lead, and zinc declined significantly during the year. Mining and quarrying represented less than 0.5% of the GDP in 1977, whereas the hydrocarbon sector's contribution was about 28%. Approximately 60% of Algeria's nonhydrocarbon mineral production was consumed domestically. Domestic demand consumed nearly 8% of crude oil production and 10% of natural gas output.

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Table 1.—Algeria: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Antimony concentrate:			
Gross weight	e150	--	--
Metal content	e60	--	--
Copper concentrate:			
Gross weight	1,609	e1,600	1,500
Metal content	370	e370	345
Iron and steel:			
Iron ore, gross weight thousand tons	3,188	2,800	3,200
Metal:			
Pig iron do	399	e r405	e450
Crude steel do	301	356	400
Semimanufactures do	211	e171	NA
Lead concentrate:			
Gross weight	r4,267	3,000	1,400
Metal content	r3,200	2,100	900
Mercury 76-pound flasks	28,000	31,000	30,000
Silver[e] thousand troy ounces	120	r80	40
Zinc:			
Concentrate:			
Gross weight	23,816	e13,721	e6,500
Metal content	r11,300	7,900	3,100
Smelter	20,000	r20,000	20,000
NONMETALS			
Barite, crude	67,600	75,000	50,000
Cement, hydraulic thousand tons	948	1,400	1,700
Clays:			
Fuller's earth	22,000	e22,000	e25,000
Kaolin	11,000	8,000	11,500
Bentonite	e35,000	39,000	24,400
Diatomite	10,000	e15,000	4,100
Fertilizer materials, phosphate rock thousand tons	r707	820	1,055
Gypsum and plasters[e 2]	175	175	175
Lime, hydraulic	11	e r12	e10
Salt thousand tons	125	136	142
Sodium compounds, caustic soda	e3,000	NA	NA
Strontium mineral, celestite, gross weight	--	--	5,732
Sulfur, elemental[e]	10,000	9,876	10,000
MINERAL FUELS AND RELATED MATERIALS			
Coal thousand tons	r6	e1	--
Gas, natural:			
Gross production million cubic feet	739,874	r863,051	e880,000
Marketed (including liquefied) do	336,628	r350,779	e350,000
Natural gas plant liquids (condensate)[e] thousand 42-gallon barrels	17,900	18,000	20,800
Petroleum:			
Crude[3] do	350,753	383,816	409,864
Refinery products:			
Gasoline do	6,771	6,893	6,690
Jet fuel and kerosine do	3,523	3,144	3,101
Distillate fuel oil do	11,647	10,580	10,079
Residual fuel oil do	9,835	9,222	7,266
Lubricants do	14	128	228
Other do	6,955	6,522	9,536
Refinery fuel and losses do	976	894	904
Total do	39,721	37,383	37,804

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, secondary aluminum, secondary lead, and secondary copper may be produced in small quantities, and additional crude construction materials (crude clays and stone) presumably are produced for local consumption, but output is unreported and available information is inadequate to make reliable estimates of output levels.

[2]Includes plasters as follows, in tons: 1975—49,441; 1976—e50,000; 1977—e50,000.

[3]Includes lease condensate.

TRADE

Algeria exported large quantities of crude oil, liquefied natural gas (LNG), phosphate rock, and mercury to Europe and the United States during 1977. Minor quantities of iron ore, and concentrates of copper, lead, and zinc were exported to Europe. The

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United States imported about 197 million barrels of Algerian crude oil in 1977, an increase of 47 million barrels compared with the 1976 level, which represented 8.2% of U.S. crude imports. The value of exported crude oil and refined petroleum products was approximately $5.7 billion and represented 91% of the value of Algeria's total exports. LNG exports in 1977 were 6.8 billion cubic meters, and exports of nonhydrocarbon mineral products from domestic mines were valued at approximately $45 million.

Table 2.—Algeria: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal including alloys, all forms	271	563	Belgium-Luxembourg 225; France 137.
Copper:			
Ore and concentrate	1,690	1,337	All to Bulgaria.
Metal including alloys, all forms	1,713	2,781	France 1,557; Belgium-Luxembourg 890; Egypt 334.
Iron and steel:			
Ore and concentrate thousand tons	1,386	1,734	Italy 653; Belgium-Luxembourg 649; United Kingdom 237.
Metal:			
Scrap	70,801	113,905	Italy 54,790; Spain 51,773.
Pig iron, ferroalloys, and similar materials	194,331	106,365	Italy 45,936; Egypt 19,209; United Kingdom 11,082; France 10,520.
Sponge iron, powder, shot	--	1,930	All to Italy.
Semimanufactures	r47,173	35,147	Mainly to Italy.
Lead:			
Ore and concentrate	4,695	4,555	Tunisia 2,555; Switzerland 1,200; United Kingdom 800.
Metal including alloys, scrap	--	1,200	All to Egypt.
Mercury 76-pound flasks	8,605	155	All to West Germany.
Nickel metal including alloys, all forms	r36	50	All to Belgium-Luxembourg.
Zinc:			
Matte	--	125	Do.
Metal including alloys	7,207	6,325	Egypt 3,299; Hungary 816; Belgium-Luxembourg 697.
Other:			
Ores and concentrates	24,978	NA	
Ash and residue containing nonferrous metals	--	142	All to Belgium-Luxembourg.
Metal including alloys, all forms	16	30	Netherlands 20; France 10.
NONMETALS			
Abrasives, grinding and polishing wheels and stones kilograms	(1)	(1)	All to France.
Bromine	161	--	
Cement, hydraulic	4,800	--	
Clays and clay products (including all nonrefractory brick):			
Crude:			
Kaolin and bentonite	800	460	United Kingdom 440; Tunisia 20.
Other	80	250	All to France.
Products, nonrefractory	(1)	--	
Diatomite and other infusorial earth	4,146	850	Italy 500; France 330.
Fertilizer materials:			
Crude phosphatic	213,365	555,290	France 154,831; Poland 98,424; Hungary 88,840.
Ammonia	5,453	8,046	Greece 4,033; Italy 4,013.
Gypsum and plasters	--	19	Switzerland 18; France 1.
Pyrite, unroasted	236,012	42,870	Italy 25,953; United Kingdom 16,917.
Salt	10,500	21,298	Dahomey 10,850; France 7,000; Mali 2,000.
Sulfur, sulfuric acid	5,344	--	
Other nonmetals, n.e.s.:			
Crude	1,000	2,600	All to U.S.S.R.
Slag, dross and similar waste, not metal-bearing	--	25,985	All to Italy.
MINERAL FUELS AND RELATED MATERIALS			
Gas, natural, liquefied million cubic feet	105,820	234,756	France 140,867; United Kingdom 40,422; United States 24,959.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	294,464	332,162	United States 156,491; West Germany 63,077; France 42,638.
Refinery products:			
Gasoline do	6,720	4,524	Netherlands 2,179; Italy 610; Belgium-Luxembourg 479.
Jet fuel and kerosine do	1,129	733	Dahomey 248; Netherlands 157; Egypt 147.
Distillate fuel oil do	r2,760	1,655	Dahomey 516; United States 234; West Germany 210; Notherlands 206.

See footnotes at end of table.

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Table 2.—Algeria: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum —Continued			
Refinery products —Continued			
Residual fuel oil thousand 42-gallon barrels	7,406	6,291	United States 5,573.
Lubricants ---do---	(1)	--	
Other ---do---	(1)	--	
Total ---do---	r18,051	13,203	

rRevised. NA Not available.
1Less than 1/2 unit.

Table 3.—Algeria: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Oxide and hydroxide	405	92	France 63; West Germany 26.
Metal including alloys, all forms	75,874	6,797	France 1,031; West Germany 827; U.S.S.R. 739.
Antimony metal including alloys, all forms	53	30	Belgium-Luxembourg 10; Italy 10; Turkey 10.
Arsenic:			
Natural sulfides	5	--	
Oxide and acid	45	50	All from France.
Beryllium metal including alloys, all forms	14	--	
Chromium oxide and hydroxide	11	2	Italy 1; West Germany 1.
Cobalt oxide and hydroxide	(1)	(1)	Mainly from France and United Kingdom.
Copper:			
Copper sulfate	138	1	Mainly from France.
Metal including alloys, all forms	15,491	9,885	Belgium-Luxembourg 4,221; France 2,557; Italy 1,852.
Iron and steel, metal:			
Scrap	52	11	France 10; West Germany 1.
Pig iron, ferroalloys and similar materials	12,739	12,105	West Germany 3,364; Brazil 3,000; France 1,539; Canada 1,265.
Steel, primary forms	60,245	22,425	Belgium-Luxembourg 8,932; West Germany 5,881; Japan 2,068.
Semimanufactures	313,585	601,214	Japan 144,493; Italy 126,456; France 81,924; Belgium-Luxembourg 64,056.
Lead:			
Oxides	836	1,640	West Germany 1,292; France 260.
Metal including alloys, all forms	9,647	4,120	Tunisia 2,735; West Germany 711.
Magnesium metal including alloys, all forms	r1	(1)	NA.
Manganese oxide	1,216	562	West Germany 295; Greece 166; France 99.
Mercury ---- 76-pound flasks	1,267	146	West Germany 117; France 22.
Nickel metal including alloys, all forms	21	77	United Kingdom 47; France 23.
Platinum-group metals and silver, including alloys:			
Platinum group ---troy ounces	1,190	1,736	Belgium-Luxembourg 1,318; United Kingdom 418.
Silver ---do---	r49,962	10,835	France 5,691; West Germany 3,119; Belgium-Luxembourg 1,608.
Rare-earth metals:			
Oxides	1	1	Mainly from France and Italy.
Metal including alloys	13	(1)	All from West Germany.
Tin metal including alloys, all forms	145	82	Spain 38; Malaysia 20; France 17.
Titanium:			
Ore and concentrate	322	462	Australia 382; France 80.
Oxide	479	1,883	West Germany 1,570.
Tungsten metal including alloys, all forms	(1)	1	Mainly fromUnited Kingdom.
Zinc:			
Ore and concentrate	--	12,521	Peru 10,145; Tunisia 2,375.
Oxide	251	472	West Germany 360; Belgium-Luxembourg 50; France 41.
Metal including alloys, all forms	3,610	501	France 251; West Germany 204.
Zirconium ore and concentrate	15	4	Mainly from West Germany.

See footnotes at end of table.

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Table 3.—Algeria: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Other:			
Ore and concentrate	61	(1)	Mainly from France.
Oxides, hydroxides, peroxides, n.e.s	742	266	Spain 250; France 10.
Metals including alloys, all forms:			
Metalloids	328	57	Italy 45; West Germany 12.
Pyrophoric alloys	(1)	(1)	Mainly from West Germany.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	102,192	89,920	Italy 35,841; Greece 4,000.
Grinding and polishing wheels and stones	553	634	Italy 238; Switzerland 122; France 113.
Dust and powder of precious and semiprecious stones	--	(1)	All from Australia.
Asbestos	4,582	11,852	U.S.S.R. 3,385; Canada 3,171; Australia 1,953.
Barite and witherite	27,495	45,100	Italy 12,712; Britain 9,400; Tunisia 6,830; Ireland 6,300.
Boron materials:			
Crude natural borates	6	26	Italy 24.
Oxide and acid	24	264	United States 201; Italy 41; France 21.
Bromine	11	(1)	All from Japan.
Cement thousand tons	1,981	2,130	Spain 1,044; Greece 384; France 218; U.S.S.R. 218.
Chalk	20,949	10,676	France 8,326; Belgium-Luxembourg 1,600.
Clays and clay products (including all refractory brick):			
Crude:			
Kaolin	6,281	12,769	Mainly from United Kingdom.
Other	5,206	5,497	Spain 2,331; U.S.S.R. 1,804; United Kingdom 936.
Products:			
Refractory (including nonclay brick)	30,392	49,178	U.S.S.R. 28,549; France 7,481; West Germany 5,444.
Nonrefractory	7,764	4,228	Spain 3,566.
Cryolite and chiolite	8	--	
Diamond, industrial thousand carats	2,380	8,030	Mainly from Zaire.
Diatomite and other infusorial earth	10	75	Netherlands 30; United States 21; Belgium-Luxembourg 10.
Feldspar	951	1,371	Italy 1,147; West Germany 102.
Fertilizer materials:			
Crude and manufactured:			
Nitrogenous	152,719	127,288	Poland 63,818; Romania 35,017; Bulgaria 12,807.
Phosphatic	20,100	74,329	United States 40,770; Romania 30,460.
Potassic	68,608	87,728	Italy 24,805; Spain 12,923.
Other, including mixed	2	62,212	United States 28,428; Spain 20,372; Italy 7,132.
Ammonia	38,572	26,305	Finland 8,036; Japan 7,885; Netherlands 5,499; Portugal 3,291.
Fluorspar	489	118	West Germany 84; France 20; Netherlands 14.
Graphite, natural	98	122	West Germany 80; U.S.S.R. 22; France 11.
Gypsum and plaster	5,881	1,168	France 929; Italy 101.
Iodine	1	(1)	Mainly from Japan.
Lime	4,026	4,456	Spain 3,097; France 1,352.
Magnesite	216	313	Mainly from Australia.
Mica, crude, including splittings and waste	15	--	
Pigments, mineral:			
Natural crude	170	510	France 479.
Iron oxides, processed	852	578	West Germany 392; France 110.
Salt and brine	28	13	West Germany 10; Switzerland 3.
Sodium and potassium compounds, n.e.s	11,667	14,466	Italy 10,117; Romania 2,000.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	10	49	Mainly from France.
Worked	69	82	Belgium-Luxembourg 52; West Germany 20.
Dolomite, chiefly refractory grade	2,207	490	Sweden 210; France 80; Netherlands 70.
Gravel and crushed rock	6,585	3,261	Italy 3,149.
Quartz and quartzite	695	780	Belgium-Luxembourg 450; Italy 257; France 60.
Sand, excluding metal bearing	2,089	3,071	Belgium-Luxembourg 2,101; United States 569; France 328.

See footnotes at end of table.

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Table 3.—Algeria: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Sulfur:			
Elemental:			
Other than colloidal	82,420	28,940	Poland 25,910; Italy 3,014.
Colloidal	975	10,804	Spain 10,104.
Sulfur dioxide	67	489	West Germany 323; Spain 166.
Sulfuric acid	19,517	50,583	West Germany 38,341; Italy 6,010; Netherlands 3,065.
Talc, steatite, soapstone, pyrophyllite	3,425	2,824	United Kingdom 1,877; France 667; Australia 150.
Other nonmetals, n.e.s.:			
Crude:			
Vermiculite, perlite, chlorite	704	465	Greece 446.
Other	158	(1)	All from France.
Oxides and hydroxides of magnesium, strontium, barium	7	4	United States 2; France 1; Belgium-Luxembourg 1.
Fluorine, elemental	90	1	Mainly from France.
MINERAL FUELS AND OTHER RELATED MATERIALS			
Asphalt and bitumen, natural	10	--	
Carbon black	2,869	2,245	West Germany 886; United Kingdom 864; Spain 345.
Coal, all grades, including briquets	36,493	22,511	U.S.S.R. 13,074; West Germany 9,437.
Coke and semicoke	236,142	216,688	Italy 92,840; U.S.S.R. 77,527; Poland 31,321.
Hydrogen, helium, rare gases	121	116	Mainly from France.
Peat	32	--	
Petroleum:			
Crude, thousand 42-gallon barrels	(1)	(1)	NA.
Refinery products:			
Gasoline, do.	r514	39	Netherlands 25; Italy 13.
Jet fuel and kerosine, do.	13	(1)	All from Netherlands.
Distillate fuel oil, do.	r313	565	Italy 387; U.S.S.R. 178.
Residual fuel oil, do.	500	623	Italy 504; U.S.S.R. 119.
Lubricants, do.	523	565	United Kingdom 550.
Other:			
Liquefied petroleum gas, do.	272	576	Saudi Arabia 291; Venezuela 284.
White spirits, do.	r29	30	Netherlands 24; France 6.
Petroleum jelly and wax, do.	57	21	Mainly from West Germany.
Asphalt and bitumen, do.	394	384	Spain 154; Albania 109; Italy 82; France 34.
Petroleum coke and flux, do.	2	(1)	Mainly from France and United States.
Unspecified, do.	r12	15	United Kingdom 10; West Germany 3; France 2.
Total	r2,629	2,818	
Mineral tar and other coal, petroleum, or gas-derived crude chemicals	r745	1,709	West Germany 1,211; Netherlands 298.

rRevised. Not available.
1Less than 1/2 unit.

COMMODITY REVIEW

METALS

Aluminum.—Algeria planned to bring its first aluminum smelter online in 1982. The 125,000-ton-per-year plant was to be built with assistance from the Soviet Union at M'sala in the Sétif district of north-central Algeria. Raw materials for the project, mainly alumina, would be imported from Jamaica and Guinea. Negotiations were underway with the U.S.S.R. for the construction of a second 125,000-ton-per-year aluminum smelter, but no agreement had been finalized by yearend.

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Iron Ore.—Expansion of the Quenza-Bou Khadra iron ore mining operation was completed in 1977, raising capacity to 5 million tons per year. Production increased by 400,000 tons to 3.2 million tons in 1977, which reversed the downward trend of the previous 2 years.

Late in 1977, Canadian Pacific Consulting Service Ltd. was commissioned to perform an engineering study for a planned 1,500-kilometer mining railway system to be built in western Algeria. The railway would link the 1,000-million-ton iron ore deposit at Gara Djebilet to a new export harbor on the Western Mediterranean at the mouth of the la Macta River near Oran. The study was to commence in early 1978 and require 2 1/2 years for completion.

Iron and Steel.—The expansion of the El Hadjar steel plant continued in 1977. The expansion was to be completed in 1979 and raise Algeria's raw steel capacity to 2 million tons per year.

In April, Société Nationale de Siderurgie (SNS) signed a contract with a Belgian engineering firm to supervise the construction of a 1.2-million-ton-per-year steel mill to be built 12 kilometers east of Djidjelli on the Mediterranean coast. The project was to use domestic natural gas as a reductant and require the construction of port facilities, a new thermal power station, rail and road connections, and a village to house the steel mill employees.

Mercury.—During 1977, Algerian mercury production of 30,000 76-pound flasks accounted for nearly one-eighth of primary world mercury production. Algeria maintained a high production level despite low prices on the world market and a domestic demand of only 200 flasks per year.

Other Metals.—SONAREM continued investigations to assess the mineral potential of the Ahaggar massif south of the Hoggar Mountains in the remote desert region of southern Algeria where deposits of gold, tin, tungsten, and uranium have been located. Hydrogeologic investigations reportedly found sufficient quantities of water to support the development of uranium deposits at Timgaouine and Abankor. SONAREM planned to initiate the production of approximately 700 tons per year of U_3O_8 in the early 1980's from Ahagger vein deposits.

NONMETALS

Barite.—SONAREM planned to increase barite production capacity to 150,000 tons per year by expanding the Mizab and Affensou mines, and to complete construction of a 50,000-ton-per-year grinding plant at Mekla. During 1977, barite production decreased 33% compared with the 1976 level and was below domestic demand of about 80,000 tons.

Cement.—Algerian cement capacity increased to 4.5 million tons per year when the 1-million-ton-per-year plants at Zahana near Oran and at Al Asnam near Algiers were commissioned. Cement production has not met domestic demand for years and, in an effort to reduce cement imports, Société Nationale des Matériaux de Construction (SNMC) was in the midst of an expansion program to bring Algerian cement capacity to over 10 million tons per year by 1980. Cement plants under construction in 1977 included four plants scheduled for completion in 1978 at Ain el Kebira near Sétif, Beni Saf near Oran, Hamma-Bouziane near Constantine, and Saida near Mascara; a second 1-million-ton-per-year plant at Al Asnam to be brought on-line in 1979; and three plants to be completed in 1980 at Bouira, Batna, and Djelfa.

Phosphate Rock.—Based on an estimated reserve of 200 million tons of phosphate rock grading, 55% bone phosphate of lime at Djebel Onk, Algeria planned to increase production capacity to 6 million tons per year by 1980. Phosphate production increased to over 1 million tons, and exports rose 26% over those of 1976 to 698,000 tons, with 656,000 tons going to the European market. A new 90,000-ton-per-year dedusting plant was commissioned at Djebel Onk late in the year. SONAREM planned to build a new fertilizer complex at Tebessa that was to produce 528,000 tons per year of sulfuric acid, 165,000 tons per year of P_2O_5 phosphoric acid, and 285,000 tons per year of triple superphosphate.

In September SONAREM signed a new 3-year agreement to continue phosphate rock shipments to Hungary, although the details of the agreement were not announced. Algeria exported 89,000 tons of phosphate rock to Hungary in 1976 and 130,000 tons in 1977. In August, SONAREM agreed to supply Finland's Kemira Oy with 60,000 tons per year of phosphate rock in return for viscose fiber (rayon) of equal value. The period covered by the agreement was from 1977 through 1979 with provisions for possible extension. In May, SONAREM contracted to ship phosphate rock to Brazil, and Brazil agreed to begin shipments of

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automobiles to Algeria commencing in October. By yearend, Algeria had shipped approximately 87,000 tons of phosphate rock to Brazil.

MINERAL FUELS

Natural Gas.—Marketed Algerian natural gas production was approximately 8.7 billion cubic meters in 1977. By yearend, based on a reserve of 3,550 billion cubic meters of natural gas, Algeria had negotiated contracts for the export of approximately 76 billion cubic meters of natural gas per year with most deliveries to begin the 1980-84 period. Firm contracts included 44 billion cubic meters to be shipped as liquefied natural gas (LNG) and 12 billion as pipeline gas. Two LNG contracts for 10 billion cubic meters per year each, which had been negotiated with U.S. companies, had not received U.S. Department of Energy approval by yearend 1977.

To meet its commitments, Algeria embarked on a huge expansion program to develop the full spectrum of facilities required to produce 110 billion cubic meters per year of pipeline gas and 22 million tons per year of natural gas liquids (NGL). Additional pipelines were to be built to connect the prolific Hassi R'Mel field to Skikda and Arzew where LNG facilities were in operation and under construction.

Table 4.—Algeria: LNG plants in operation, under construction, and planned (1977)

Plant	Location	Capacity (billion cubic meters per year)	Startup date
Camel	Arzew	1.5	1964
Skikda 1:			
Trains 1, 2 and 3	Skikda	4.2	1972-1973
Trains 4	do.	1.2	1978
Trains 5 and 6	do.	3.0	1979
LNG-1	Arzew	10.5	1978
LNG-2	do.	10.5	1980
LNG-3	do.	15.75	1981
LNG East	Skikda	10.5	NA
LNG Center	Algiers	15.75	NA
Total		72.9	

NA Not available.

SONATRACH signed a contract in May with Japan Gasoline Co. Ltd., and C. Itoh & Co. for the construction of a fifth natural gas processing facility at Hassi R'Mel that would produce 21 billion cubic meters per year of dry gas and 4.5 million tons per year of NGL. Italy's Ente Nazionale Idrocarburi (ENI) and SONATRACH signed an agreement in October for the delivery of 12 billion cubic meters per year of natural gas to Italy. Natural gas, which was to be shipped by pipeline, will originate at Hassi R'Mel, pass through Tunisia to Cape Bon, cross the Mediterranean under the Straight of Sicily, traverse Sicily, and cross the Strait of Messina to the Italian mainland. Projected cost of the pipeline was $3.0 billion, with deliveries commencing in 1981.

The Government of Algeria planned to have all the components of the natural gas expansion scheme online by 1985. When in full production, natural gas and NGL are expected to provide Algeria with approximately $6 billion per year in foreign exchange earnings.

Petroleum.—During 1977, petroleum production increased 6.5% compared with that of 1976, and output of 53.5 million tons was the highest production level attained in Algeria. Approximately 90% of production was exported as crude; the remainder was processed by domestic refiners. Exports of petroleum products were estimated at 1.4 million tons during the year.

Drilling activity in Algeria was sustained at a fairly high level and resulted in 11 oil wells and 30 gas wells during the year. Of the total footage drilled during 1977, less than 25% was for exploratory drilling; and of 11 wildcats spudded by companies working with SONATRACH, 1 found oil, 1 gas, and 9 were dry. Total Algerie drilled the country's first offshore well, the Hobibas 1, a dry hole, approximately 115 kilometers off Oran in water 1 kilometer deep.

Algeria's petroleum refineries at Arzew, Algiers, and Hassi Messaoud had a combined capacity of 5.7 million tons per year in 1977, and output was approximately 4.95 million tons during the year. Algeria plan-

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ned to increase domestic refining capacity to about 30 million tons per year with new oil refineries at Skikda (15 million tons per year), Hassi Messaoud (1 million tons per year), In Amenas (500,000 tons per year), and Bejaĭa (7.5 million tons per year). The Skikda, Hassi Messaoud, and In Amenas plants were scheduled to come onstream in 1979-80. The Bejaïa refinery was in the planning stage.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Algerian dinars (DA) to U.S. dollars at the rate of DA4.035=US$1.00.

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The Mineral Industry of Angola

By Janice L. W. Jolly[1]

Crude petroleum production continued to be the mainstay of the Angolan economy, which was still laboring at the low levels brought about by the civil war. Both petroleum and diamond production increased over those of 1976. Estimated variously at $600 million to $800 million,[2] petroleum revenues provided most of the Government's operating revenue and were the major component of the 1977 gross domestic product (GDP) estimated to be 50% to 80% below the 1974 level of $3 billion. A long list of nationalizations and seizures of abandoned businesses was announced as the Government began measures toward reconstruction. A new currency, the kwanza, was announced in January. The kwanza, divided into 100 lwei, replaced the Angolan escudo and is not convertible on the international market.[3]

With Angola's industrial production running at about 40% of pre-civil war levels and with a serious shortage of skilled workers preventing utilization of production capacities, the ruling Movimento Popular para a Libertação de Angola (MPLA) Congress was considering the steps necessary for economic recovery. These included giving the mining, petroleum, and industrial sectors high development priority.[4]

Measures to be adopted as a basis for reconstruction included the following: The State industry sector was to be enlarged and consolidated by nationalization. Government enterprise activities were to be improved and were to set standards for the expected creation and operation of new mixed private-Government enterprises. Government guidelines were to be established for private enterprises so that their operation would coincide with more general interests of the national economy. Industrial production and distribution were to be subject to Government control and planning. Literacy and technical training were to be developed for all branches of industry. New ministries or directorates were to be formed to carry out specific tasks.

National Directorates for Electrical Energy, for the Petroleum Industry, and for Geology and Mining Industry were established by Decree No. 66/77 on August 14. The National Directorate for Geology and Mining Industry, under the Ministry of Industry and Power, was to assume a special significance in laying the foundations for a mineral policy and creating the conditions for rational development of the mineral industry. This was to include formation of a new national geological map, concentrating efforts on areas of greatest interest.

Efforts were to be made to revive mining operations by reequipping them and taking the necessary reorganization and technical assistance measures. A new mining law was to be drafted and published. The petroleum industry was to gradually increase output, and the national fuel company, Soc. Nacional de Combustiveis de Angola (SONANGOL), was to be strengthened to insure the Government's leading role in the development of the petroleum industry. Exports of refined petroleum products were to be increased, as were other mineral exports.

An all-out effort to improve basic infrastructure such as electricity, roads, and ports was also planned. It was considered particularly important to build the port at Cabinda. Studies were also to be undertaken for the expansion of ports at Luanda, Lobito, and Moçâmedes, which would consider the need for a container facility, construction of new warehouses, and better connections with roads and railroads. The

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shortage of technicians affected practically every sector. Angola's largest power company, providing 60% of the nation's electricity, was operating with half the skilled personnel considered adequate.

Tanganyika Concession's Benguela Railway in Angola continued to operate within the country under great difficulties, but had carried no international traffic since August 1975. No income was received from the Railway, whose future depended upon resumption of international traffic. The line was open between Lobito and Bié and from the Zaire border to Luena, but the central portion was far from secure. A decree was issued in May 1977 canceling the concession for operation of the Amboim railroad and port, which had been operated by Amboim Railway Co., Ltd., since 1923. All assets of the company were to be controlled by the Angolan Ports, Railways and Transportation Service without any indemnification. The railroad is 150 kilometers long and links the port to the city of Gabela.

The Foreign Relations Ministry published Declaration No. 159/75 that set the extent of territorial waters at 20 miles, measured from the shoreline. In high seas areas contiguous to its territorial waters, extending a distance of 200 miles from the shoreline, the State of Angola claimed the right, conferred upon it by international law, to exercise the control required to prevent violations and to guarantee the country's legitimate defense. Fishing rights also extend to the 200-mile limit.[5]

The Angolan Government continued its refusal to open the water reservoir into the Cunene River on the Angolan-South-West African frontier. As a consequence, the hydroelectric dam at Ruacaná, although complete, was not in operation. The dam, designed in 1969 in collaboration with Portuguese colonial authorities and built by the Republic of South Africa, was finished in 1977 but was unable to operate because of the Angolan veto. Cost of the Ruacaná project was estimated at over $200 million and was being borne by the South African Government. The electric power was intended for South-West African and southern Angolan areas.

PRODUCTION AND TRADE

In 1977, 62.4 million barrels of crude petroleum was produced, including about 44 million barrels from Gulf Oil Corp.'s Cabinda wells and 19 million barrels from Angola proper. Large production increases were credited to the N'Zombo (1973) and Quinfuquena (1975) wells, which were producing an average of 39,194 barrels and 6,799 barrels per day, respectively.[6]

Angola was to begin selling oil to Zambia, and there was discussion of building an oil pipeline between the two countries. In August, there were reports that a road link was being planned to connect the Zambian Copperbelt to the Benguela Railway, bypassing Zaire.

Total Angolan diamond production was estimated at about 353,000 carats. A 15% increase in Central Selling Organization (CSO) prices announced in March contributed to improved revenues from this sector of the mineral industry.

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Table 1.—Angola: Production of mineral commodities

Commodity[1] and unit of measure	1975	1976	1977[p]
METALS			
Beryllium: Beryl, gross weight[e] metric tons	30	30	--
Gold, mine output, metal content troy ounces	1,000	1,000	1,000
Iron ore and concentrate, gross weight thousand metric tons	2,600	--	--
NONMETALS			
Cement, hydraulic do.	[r]650	650	650
Clays: Kaolin[e] metric tons	(2)	--	500
Diamond:			
Gem[e] thousand carats	[r]743	[r]255	265
Industrial[e] do.	[r]248	[r]85	88
Total do.	[r]991	340	353
Gypsum[e] metric tons	40,000	[r]40,000	40,000
Salt[e] do.	100,000	100,000	100,000
Talc[e] do.	100	[r]100	--
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural[e] do.	40,000	40,000	45,000
Natural gas:			
Gross million cubic feet	35,000	22,000	42,400
Marketed do.	2,300	2,000	2,500
Petroleum:			
Crude thousand 42-gallon barrels	57,943	36,700	62,437
Refinery products:			
Gasoline do.	386	429	526
Kerosine do.	76	136	163
Jet fuel do.	619	446	441
Distillate fuel oil do.	1,072	949	1,469
Residual fuel oil do.	2,635	2,924	3,725
Other do.	147	120	143
Refinery fuel and losses do.	135	184	229
Total do.	5,070	5,188	6,696

[e]Estimate. [p]Preliminary. [r]Revised.

[1]In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and broken stone) presumably were produced for local consumption, but available information is inadequate to make reliable estimates of output levels.

[2]Less than 1/2 unit.

COMMODITY REVIEW

METALS

Iron Ore.—Two contracts were awarded to the Yugoslav company Energoprojekt to reopen the Cassinga iron ore mine, which has been closed since August 1975. Transport of ore in stock was part of the agreement. Angola's iron ore export terminal can accommodate 200,000-deadweight-ton ships and has a 1.2-million-ton stockpile capacity. The Krupp shiploader and terminal have a load rate of 3,500 tons per hour. Iron ore reserves at Cassinga were estimated at 100 million tons of eluvial hematite ore with 62% to 64% iron and 2 billion tons of itabirite ore with 40% to 50% iron. Taconite ore, estimated at 92 million tons with an average of 32% iron, occurs at Cassala-Quitungo.

NONMETALS

Cement.—Angola's two cement companies were included in the first series of industry confiscations in accordance with Decree No. 72/77. One was owned by Cia. de Cimento Secil du Ultramar S.A.R.L. in Luanda, and the other was owned by Cia. des Cimentos de Angola S.A.R.L. in Lobito. The Luanda plant was a fuel-oil-fired plant with a 750,000-ton-per-year capacity, and the Lobito plant had a 150,000-ton-per-year capacity. Industrial Construction Co. and other cement and ceramic products companies headquartered in Luanda were also confiscated. The State-owned National Cement Enterprise was to be established with headquarters in Lobito under the jurisdiction of the Ministry of Construction and Housing.[7]

Diamond.—On August 30, a decree was published expanding the Angolan Government's 11% holding (200,000 shares) in Cia. de Diamantes de Angola (DIAMANG) to 60.85% (1,052,755 shares). The amount and manner of indemnity for the nationalized Portuguese shares were to be determined by the Angolan Council of Ministers. The right to indemnity may be denied to former holders of nationalized shares found guilty

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of fraud. Shares not subject to the nationalization were owned by the following companies: Soc. Générale de Belgique S.A., Soc. d'Entreprise et d'Investissements de Beceka S.A. (SIBEKA), Diamond Corp. (Pty.) Ltd. (a subsidiary of the De Beers group), John S. G. Memorial Foundation, S. R. and D. F. Guggenheim Foundations, Pacific Tin Consolidated Corp., Morgan Guaranty and Trust Co., G. E. Bank Co., Pinto Magalhaes Bank, Portuguese Intercontinental Bank, Totta and Acores Bank, National Overseas Bank, Portuguese Atlantic Bank, Fonsecas and Burnay Bank, Caixa General Deposit and Social Security Fund, Lisbon Water Co., Tagus Insurance Co., Labor Insurance Co., Swiss Banks Co., and Swiss Bank Corp. At a special meeting on November 29, DIAMANG's new directors were elected; of the eight directors, four were Angolans, including the chairman of the board. Two directors were to represent the Belgian stockholders group, and the British and United States groups each had one representative. Approximately 18,000 persons were reported as employed in diamond mining in the Lunda District.

DIAMANG's 1977 diamond production was reported at 352,700 carats, up about 4% over the lowest level of 1976. As a result of higher diamond prices during the year, revenues rose more sharply. Plans were being made to increase production, including recruitment of more expatriate workers. A management contract was under negotiation with De Beers.

The Diamond Security Department (DSD) was established under the Directorate of Intelligence and Security of Angola (DISA). With its headquarters in Dundo and sections located at Andrada, Cuando, and Luanda, the DSD was to coordinate its activities with DIAMANG and civil police corps in maintaining surveillance of all operations involving prospecting, mining, classification, evaluation, transportation, and marketing of diamond, with special care for its security and prevention of illegal traffic in diamond.[8]

Fertilizer Materials.—*Phosphate Rock.*—Phosphate exploration and the fertilizer plant project may be revived. A meeting was held with Bulgarian representatives to discuss possible Bulgarian technical cooperation in an exploration program. In 1975, it had been reported that Ammonição Portuguese had plans for a $40 million fertilizer complex using phosphate rock at Caala.

Salt.—The Ministry of Internal Trade issued new regulations for the sale of salt in the country to provide more equitable distribution. All salt-producing companies were obligated to sell their entire salt production to the National Food Products Distributing Co. These firms were to receive production quotas in accordance with guidelines issued by the State Wholesale Firm for Internal Trade in the province in which the production unit was located. Measures were taken to improve wages for workers at the Capulo saltworks in Ambriz.

MINERAL FUELS

Petroleum and Natural Gas.—The national petroleum company SONANGOL was negotiating a new contract with Gulf for production, prospecting, and development of petroleum in Cabinda. SONANGOL, the only firm with mineral rights for exploration and production of liquid and gaseous hydrocarbons, was expected to acquire at least 51% of Cabinda Gulf Oil Co. Talks were being held with Texaco Inc. and the Belgian firm Petrofina S.A. on possible oil prospecting off the northern Angolan shore. The former Portuguese- and Belgian-operated (Petrofina) companies Soc. Portuguesa Exploração de Petroleos Angol S.A.R.L. and Cia. de Petróleos de Angola (PETRANGOL) were already nationalized by the MPLA Government. Petrofina held 59% of the shares in the Luanda refinery.

Petroleum was being produced mainly from the Cabinda enclave, where Gulf had numerous offshore wells. Cabinda's production began from the Malongo North and Malongo South Fields in 1968 and reached a peak of 167,000 barrels per day in 1974. Gulf's production fell sharply after the civil war to 78,000 barrels per day during 1976, but increased again to an average of 122,700 barrels per day in 1977. Gulf's production constituted about 71% of Angola's total crude petroleum output. The PETRANGOL fields (Texaco, Angol, and Petrangol) of northern Angola accounted for the remainder.

Cabinda Gulf Oil planned to initiate new projects costing $38 million. About half of this sum was to be furnished by the Angolan Government under new contractual arrangements. The investments were to include a gas injection scheme to improve recovery from existing wells and exploration for new offshore wells. Angola received tax and royalty payments from Gulf estimated at $460 million in 1977, which provided an estimated 60% to 80% of the Angolan

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Government's operating revenue.

Angola's proved crude oil reserves were estimated at 1.2 billion barrels in January and natural gas reserves at about 1.1 trillion cubic feet. Natural gas was being produced at an average rate of 7 billion cubic feet per month.

PETRANGOL awarded the Italian company SNAM Progetti S.p.A. a contract for construction of a new marine terminal at Quinfuquena on Angola's northern coast. To include onshore and offshore pipelines, a tank farm, and pumping station, the terminal was expected to be completed by early 1980.[9] PETRANGOL's Luanda petroleum refinery was producing about 14,000 barrels per day of refined products; it had a processing capacity of about 32,000 barrels per day.

Decree No. 85/76 extended the prospecting period for the PETRANGOL concession zone to December 31, 1977, which made it possible to reexamine projects and continue prospecting in the Soyo region on the N'Zombo and Quinfuquena structures. Onshore in the Cuanza Basin, reinterpretation and study of geological and seismic data previously recorded were undertaken. The final demarcation of the Legua deposit was completed. Talks were started with the Government on dividing the activities of the company into separate enterprises, with one devoted to petroleum prospecting and production and the other to refining.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Angolan kwanzas (AKz) to U.S. dollars at the rate of AKz1 = US$0.0413.

[3]Diario de Noticias (Lisbon). Revolutionary Currency Established. Jan. 8, 1977, p. 12.

[4]People's Republic of Angola (Luanda). Essential Objectives, Tasks of Angolan Reconstruction. December 1977, pp. 3-76.

[5]Jornal de Angola (Luanda). Foreign Minister Addresses Media on Territorial Water Rights. Jan. 29, 1977, pp. 1-2.

[6]Oil and Gas Journal. Worldwide Production. Dec. 29, 1977, p. 89.

[7]Jornal de Angola (Luanda). National Cement Company Formed. May 17, 1978, p. 1.

[8]Jornal de Angola (Luanda). Department Created to Protect Diamonds. June 22, 1978, pp. 2 and 6.

[9]Petroleum Economist (London). Africa. V. 45, No. 7, July 1979, p. 308.

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The Mineral Industry of Argentina

By Orlando Martino[1]

The Argentine economy recovered in 1977 following the production declines of the 2 prior years. With a real growth of 4.7%, the gross domestic product (GDP) was estimated at $48.5 billion[2] at current prices. Although the rate of inflation was reduced by one-half, it continued high at 170%, among the highest in the world.

Although Argentina has substantial mineral potential, the value of nonfuel mineral output in 1977 represented less than 1% of the GDP. The value of petroleum and natural gas output, however, was 1.2% of the GDP and increased 8% over that of 1976. The major part of the country's limited mineral production was oriented to meeting the needs of the industrial sector. Imports of alumina, copper, iron ore, manganese ore, and metallurgical coal were required to satisfy growing domestic demand.

As the third largest producer of crude petroleum and one of the leading producers of natural gas in Latin America, Argentina was less dependent upon foreign energy sources. State-owned Yacimientos Petrolíferos Fiscales (YPF) and Gas del Estado were actively engaged in investment programs to enable Argentina to gain self-sufficiency in these mineral fuels by 1985. Argentina had the leading position in Latin America in the application of nuclear reactor technology and during the year became an exporter of this technology to the region for the first time. During 1977, new plant capacity was added for producing uranium concentrate to support the country's nuclear energy program.

The copper-molybdenum discovery at Famatina in La Rioja Province on the eastern side of the Andean Range was an important result of the activities of the Servicio Minero and Derección General de Fabricaciones Militares (DGFM), the Army's industrial complex with large mining interests in Argentina. Further exploration was underway to determine its potential for domestic and foreign investment.

Government Policies and Programs.—The Military Junta continued its economic stabilization program to reduce the country's strong inflation. Nonetheless a substantial increase in gross fixed investment during 1977 increased the demand for minerals, metals, and other raw materials. Following promulgation of the liberal Foreign Investment Law of August 1976, the increase in direct foreign investment reflected renewed confidence in the investment climate of Argentina. The Government publicly welcomed foreign investment and issued new laws providing for more favorable treatment. Efforts were also made to reduce the Government's role in the economy.

The proposed new Argentine mining legislation remained stalled in the executive branch, and there was no indication of when it would be submitted to the Legislative Advisory Council. The proposed law was considered important to certain pending foreign mineral investments such as the large El Pachón copper project. In July, the Government issued Industrial Promotion Law No. 21608 to strengthen the participation of private enterprise and, among other objectives, to further the installation of new industries in frontier areas and facilitate the transfer of industries away from densely populated cities. Special promotional benefits would be granted to industries that developed regional raw materials processing plants such as smelters and ore concentrators.

The Government also promulgated new

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transfer of technology through Law No. 20794 in August 1977 which replaced earlier restrictive legislation that greatly impeded the flow of technology to Argentina.

The Government approved a new law to regulate risk association contracts for oil exploration in onshore and offshore areas, and in October, a call for bids was initiated in the Tierra del Fuego zone. As a first step in determining investment priorities in the energy sector, the Secretariat of Energy prepared a global energy balance for the period 1977-85. The Government announced a vast $24 billion plan of investments during a 10-year period providing for the drilling of 7,000 wells with the objective of increasing oil production from 424,000 barrels to 640,000 barrels per day. The energy plan would also expand and strengthen the coal industry and provide for construction of new hydroelectric and nuclear power stations. Of the total, $11.3 billion would be invested directly in the petroleum industry.

The Servicio Geológico Nacional was carrying out an exploration program in the Patagonia region, south of Bariloche in the Andean Cordillera, Santa Cruz Province, where the primary targets are copper and lead.

Argentina took steps to begin exploiting its untapped mineral reserves in the north by opening to development a 550-square-kilometer zone in Catamarca Province that was part of the Federal reserve. This zone was reported to have reserves of copper, manganese, gold, and silver. More than 90% of Argentina remained to be systematically explored.

PRODUCTION

Provisional Government data indicate that nonfuel mineral output on a gross tonnage basis increased 5% in 1977. The greatest growth took place in nonmetallic ores (7%), while output of metallic ores increased 3%. Among nonmetals, notable increases occurred in output of boron minerals (borates) (19%), diatomite (13%), feldspar (13%), fluorspar (11%), and mica (10%); graphite decreased 20%. Production of copper ores increased 7% but continued far short of domestic requirements. Output of iron ore, tin ore, and lithium minerals increased 5%, 6%, and 8%, respectively. Manganese ore output increased only slightly in 1977 but was 70% above the 1975 output. Notable declines were in tungsten ore (11%) and beryllium (8%).

Among mineral fuels, production of coal continued to fall short of targeted increases. The rebound in output of crude petroleum strenthened but remained below the peak of 1972. Natural gas output was up 14%, continuing the upward trend of the decade. Production of uranium concentrate (yellow cake) increased subtantially as new concentration capacity came onstream at Don Otto and Puesto de Los Adobes in Salta and Chubut Provinces.

Table 1.—Argentina: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Antimony, mine output, metal content—kilograms	900	2,200	2,200
Beryllium, beryl concentrate, gross weight	167	112	103
Bismuth	374	--	--
Chromium, chromite, gross weight	30	--	--
Columbium-tantalum, columbite-tantalite concentrates, gross weight—kilograms	1,791	282	282
Copper:			
Mine output, metal content	380	265	283
Smelter[e]	80	60	70
Gold, mine output, metal content—troy ounces	5,818	5,803	[e]5,800
Iron and steel:			
Iron ore and concentrate, gross weight—thousand tons	286	506	531
Pig iron—do	1,043	1,306	1,380
Ferroalloys, electric furnace—do	52	[e]50	[e]50
Crude steel—do	2,244	2,422	2,676
Semimanufactures[2]—do	2,236	2,004	NA
Lead:			
Mine output, metal content	30,046	33,004	33,305
Smelter	36,000	50,000	45,000
Manganese ore and concentrate, gross weight	51,219	53,086	53,272

See footnotes at end of table.

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Table 1.—Argentina: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS —Continued			
Silver, mine output, metal content thousand troy ounces	2,316	2,250	e2,200
Tin, mine output, metal content	538	r358	379
Tungsten, mine output, metal content	58	62	55
Uranium, mine output, U_3O_8 content kilograms	37,914	205,437	199,630
Zinc:			
Mine output, metal content	37,351	40,593	40,934
Smelter	39,500	35,200	29,000
NONMETALS			
Asbestos	1,130	889	882
Barite	37,431	40,546	41,637
Boron materials, crude	76,629	80,851	96,455
Cement, hydraulic thousand tons	5,464	5,712	6,002
Chalk	50,013	58,109	63,838
Clays:			
Bentonite	126,737	132,313	145,438
Foundry earth	200	211	201
Fuller's earth (decolorizing clay)	2,927	3,133	3,090
Kaolin	113,482	83,726	89,218
Refractory	154,019	119,233	126,184
Other thousand tons	2,262	2,056	2,183
Diatomite	15,905	13,850	15,716
Feldspar	63,845	68,224	77,359
Fertilizer materials:			
Crude, natural phosphates (guano)	876	e1,000	e1,000
Manufactured:[3]			
Nitrogenous	47,445	25,446	NA
Phosphatic, Thomas slag	3,459	1,693	NA
Ammonia, anhydrous[3]	1,350	2,592	NA
Fluorspar	54,358	40,077	44,473
Graphite	15	145	117
Gypsum, crude	612,733	507,125	554,947
Lithium, spodumene, amblygonite, gross weight	487	675	730
Mica:			
Sheet	412	329	2,890
Waste and scrap	2,490	2,291	NA
Pigments, natural mineral: Ocher	240	174	176
Precious and semiprecious stone: Amethyst kilograms	3,000	500	NA
Pumice and related volcanic materials	59,849	57,593	63,597
Rhodochrosite	18	11	11
Salt:			
Rock thousand tons	1	1	1
Solar do	1,566	660	703
Total do	1,567	661	704
Sand and gravel:			
Sand:			
Construction do	13,866	14,893	16,459
Silica sand (glass sand) do	187	269	280
Gravel do	6,382	5,990	6,816
Stone:			
Dimension:			
Flagstone	100,271	84,472	97,301
Granite:			
Blocks	32,919	24,699	27,955
Other forms	8,825	8,250	7,712
Marble and other calcareous, n.e.s	36,206	50,675	56,471
Sand stone thousand tons	49	48	50
Crushed, broken, unspecified:			
Basalt do	2,151	2,517	2,996
Calcite, nonoptical do	17	12	13
Dolomite do	239	245	258
Granite, crushed do	4,936	4,343	4,671
Limestone do	12,824	13,608	14,121
Marble rubble do	58	69	63
Quartz do	r124	116	126
Quartzite do	1,362	1,769	1,328
Serpentine do	40	56	60
Shell marl do	637	605	717
Tuff do	1,757	2,006	1,179
Strontium minerals, celestite	1,467	2,054	2,209
Sulfates, natural:			
Aluminum (alum)	24,806	24,800	26,751
Magnesium (epsomite)	6,261	12,412	13,144
Sodium (mirabilite)	51,392	38,489	39,148
Sulfur, elemental, refined	30,897	33,954	33,828
Talc and related materials:			
Pyrophyllite	8,357	9,132	9,228
Steatite	328	840	857
Talc	40,081	44,185	46,288

See footnotes at end of table.

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Table 1.—Argentina: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
NONMETALS —Continued			
Vermiculite	3,412	4,098	4,173
Zeolite	25	23	23
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	4,424	818	840
Carbon black	30,000	30,000	30,000
Coal, bituminous thousand tons	502	615	528
Coke, all types, including breeze do	766	738	[e]740
Gas, natural:			
Gross production million cubic feet	362,860	453,375	[e]455,500
Marketed do	[r]271,639	272,288	278,000
Natural gas liquids:			
Natural gasoline thousand 42-gallon barrels	472	447	NA
Butane do	1,687	3,248	[e]3,700
Propane do	1,539	NA	NA
Total do	3,698	3,695	[e]3,700
Peat, agricultural	24,611	9,532	12,961
Petroleum:			
Crude thousand 42-gallon barrels	144,363	145,561	157,248
Refinery products:			
Gasoline do	32,475	34,071	35,916
Jet fuel do	3,598	3,784	4,054
Kerosine do	6,104	6,178	5,872
Distillate fuel oil do	39,834	42,849	46,189
Residual fuel oil do	53,885	53,199	58,234
Lubricants do	1,784	1,615	1,986
Other:			
Liquefied petroleum gas do	7,057	7,369	--
Asphalt do	2,615	2,711	--
Petroleum coke do	4,179	--	--
Unspecified do	507		
Refinery fuel and losses do	5,798	13,882	24,607
Total	157,836	165,658	176,858

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, cadmium, lime, perlite, and urea are also produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels. Titanium-bearing iron sands are also produced with annual production of approximately 100 tons of contained metal, but recovery of titanium oxides is not attempted and the material is used for nonmetallurgical uses.

[2]Hot-rolled semimanufactures only; excludes castings and cold-rolled semimanufactures produced from imported hot-rolled semimanufactures.

[3]Data are for years ending June 30 of that stated.

TRADE

Argentina's balance of trade showed further improvement in 1977, with a trade surplus of $1.5 billion. Total exports valued f.o.b. at $5.6 billion increased 44% while imports valued (c.i.f.) at $4.1 billion increased 34%. Mineral commodities were not an important part of Argentina's international trade.

The Secretaria de Estado de Minería reported that exports of minerals and partially refined products, excluding mineral fuels and steel products, reached a record high in 1977 of $21 million, a 15% increase over that of 1976. The major export markets chiefly for nonmetals were Brazil and the United Kingdom followed by Paraguay, Italy, and the United States. The salient mineral and mineral-related exports in 1977 were steel products, $95 million; petroleum products, $25 million; boron minerals, $6.3 million; silver and tin concentrates, $3.7 million; lead ingots, $1.8 million; and uranium concentrate, $1.7 million. Exports of steel products decreased in 1977.

Nonfuel mineral imports during 1977 were valued at $803 million, a 35% decrease from those of 1975 but a 14% increase over those of 1976. Major mineral-related imports in 1977 were steel products, $360 million; crude petroleum, $298 million; refined petroleum products, $200 million; and natural gas, $89 million, mostly from Bolivia. Argentina continued to be 100% dependent on imports of metallurgical coal and

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alumina for its growing steel and aluminum industries. Domestic industry also relied heavily on imports of iron ore, pig iron, and refined copper. Imports from the United States represented 19% of Argentina's total imports. The chief mineral-related U.S. imports were anthracite and bituminous coal (1.5 million tons valued at $38 million in 1977).

In October, an Argentine trade delegation visited the U.S.S.R. The Argentines agreed to Soviet participation in bidding on the Yaciretá-Apipé and Corpus electrical projects, and the Soviets expressed interest in equipment sales to the oil and coal industries of Argentina.

Table 2.—Argentina: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum:		
Oxide (alumina) and hydroxide	2	14
Metal including alloys, all forms	89	514
Beryllium, beryl ore, and concentrate	150	--
Chromium oxide and hydroxide	(1)	1
Copper metal including alloys, all forms	130	190
Iron and steel:		
Pig iron and similar materials	23	32
Ferroalloys	30	70
Steel, primary forms	r(1)	265
Semimanufactures:		
Bars, rods, angles, shapes, sections	4,032	212,480
Universals, plates, sheets	r1,640	104,078
Hoop and strip	73	501
Rails and accessories	488	932
Wire	r3,106	865
Tubes, pipes, fittings	r24,573	22,528
Castings and forgings, rough	198	442
Lead:		
Oxide	2	496
Metal including alloys, all forms	1	1,323
Magnesium metal including alloys, all forms	25	--
Silver metal thousand troy ounces	33	--
Tin:		
Ore and concentrate	1,918	--
Metal including alloys, all forms	3	50
Zinc:		
Oxides	--	(1)
Metal including alloys, all forms	r(1)	1,217
Other:		
Ash and residue containing nonferrous metals	39	25
Oxides, hydroxides, peroxides of metals, n.e.s	--	(1)
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, etc	--	(1)
Grinding and polishing wheels and stones	r11	31
Asbestos	--	(1)
Barite	146	2
Boron materials:		
Crude natural borates	4,167	9,447
Oxide and acid	110	1,197
Borates and perborates	9,172	12,504
Cement	2,086	7,489
Chalk	304	727
Clays and clay products (including all refractory brick):		
Crude:		
Bentonite	6,560	7,494
Kaolin	--	20
Other	51	122
Products:		
Refractory (including nonclay bricks and cement)	743	564
Nonrefractory	299	656
Diatomite and other infusorial earth	10	10
Feldspar	6	--
Fertilizer materials:		
Manufactured:		
Nitrogenous	33	22
Phosphatic, Thomas slag	184	16
Mixed	90	--
Ammonia	211	165
Fluorspar	2,084	5,739
Gypsum and plasters	23,372	16,727
Lime	96	88
Lithium and lithium compounds	45	50
Mica:		
Crude, including splittings and waste	223	1,367
Worked, including agglomerated splittings	--	(1)

See footnotes at end of table.

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Table 2.—Argentina: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976
NONMETALS —Continued		
Pigments, mineral:		
Natural, crude	(1)	--
Iron oxides, processed	124	124
Precious and semiprecious stone, except diamond, natural -- kilograms	3,057	8
Salt	54,535	24,201
Sodium and potassium compounds, n.e.s	--	5
Stone, sand and gravel:		
Dimension:		
Crude	5,875	14,303
Worked	1,149	1,902
Dolomite	2,272	1,040
Gravel and crushed rock	26,032	9,333
Quartz	--	47
Sand	4,933	15
Ornamental:		
Onyx	--	30
Rhodochrosite	r5	(1)
Sulfur:		
Sulfur dioxide	(1)	10
Sulfuric acid	131	52
Talc, steatite, soapstone, pyrophyllite	271	183
Other nonmetals, n.e.s.:		
Crude	122	210
Slag, dross, and similar waste, not metal bearing	1,093	1,224
Bromine, fluorine, iodine	5	1
Oxides, hydroxides, peroxides of strontium, barium, magnesium	46	8
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	62	349
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	273	198
Carbon black	4,062	3,029
Coal, all grades	1,438	507
Coke and semicoke	r1,093	10,033
Petroleum refinery products:		
Gasoline thousand 42-gallon barrels	3	445
Distillate fuel oil do	8	98
Residual fuel oil do	5	312
Lubricants do	53	21
Other:		
Liquefied petroleum gas do	35	102
Mineral jelly wax do	20	37
Bitumen and other residues do	26	36
Bituminous mixtures, n.e.s do	r30	16
Petroleum coke do	1,032	910
Unspecified do	(1)	(1)
Total	1,212	1,977
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	9	(1)

rRevised.
1Less than 1/2 unit.

Table 3.—Argentina: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum:		
Bauxite and concentrate	29,071	20,691
Oxide (alumina) and hydroxide	105,499	50,572
Metal including alloys, all forms	51,642	21,811
Antimony:		
Ore and concentrate	580	533
Metal including alloys, all forms	(1)	(1)
Arsenic:		
Trioxide and acids	367	396
Metal including alloys, all forms	1	22
Bismuth metal including alloys, all forms	20	20
Cadmium metal including alloys, all forms	2	(1)
Chromium:		
Chromite	5,708	4,111
Oxide and hydroxide	6	1
Metal including alloys, all forms	8	3

See footnotes at end of table.

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Table 3.—Argentina: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS —Continued		
Cobalt:		
Oxide and hydroxide	12	--
Metal including alloys, all forms	84	84
Columbium and tantalum: Tantalum metal, including alloys, kilograms	19	89
Copper:		
Ore and concentrate	2,044	1,020
Metal including alloys, all forms	42,575	29,391
Gold metal, unworked or partly worked, troy ounces	73,336	7,234
Iron and steel:		
Ore and concentrate, thousand tons	1,520	1,745
Metal:		
Scrap, do	319	72
Pig iron, including spiegeleisen, do	179	72
Sponge iron, powder, shot	1,135	1,955
Ferroalloys	10,828	7,123
Ingots and other primary forms, thousand tons	1,194	791
Semimanufactures:		
Common steel:		
Bars and rods, do	11	3
Angles, shapes, sections, do	30	15
Universals, plates, sheets, do	r474	180
Hoop and strip, do	4	3
Rails and accessories	263	924
Wire	305	292
Tubes, pipes, fittings, thousand tons	9	14
Castings and forgings	115	65
High carbon and alloy steel, all forms, thousand tons	r88	28
Lead:		
Ore and concentrate	5,143	5,471
Oxides	301	23
Metal including alloys, all forms	6,116	303
Magnesium metal, including alloys, all forms	481	416
Manganese:		
Ore and concentrate	77,619	67,263
Oxides	903	1,305
Metal	75	60
Mercury, 76-pound flasks	1,153	2,401
Molybdenum:		
Ore and concentrate	5	19
Metal including alloys, all forms	13	9
Nickel metal, including alloys, all forms	1,077	581
Platinum-group metals and silver:		
Platinum group, troy ounces	2,765	1,840
Silver, thousand troy ounces	753	382
Rare-earth metals and compounds	51	62
Selenium, elemental	8	9
Tellurium, kilograms	703	53
Tin metal including alloys, all forms	1,777	987
Titanium:		
Ore and concentrate	1,568	1,809
Oxides	545	806
Metals including alloys, all forms	21	43
Tungsten metal including alloys, all forms	8	7
Zinc:		
Ore and concentrate	r23,313	3,254
Oxides	131	203
Metals including alloys, all forms	4,744	3,259
Zirconium ore and concentrate	108	10
Other:		
Ore and concentrate	744	739
Oxides, hydroxides, peroxides of metals, n.e.s	476	544
Metals including alloys, all forms:		
Metalloids	3,972	3,940
Pyrophoric alloys, kilograms	461	214
Base metals including alloys, all forms, n.e.s	2	3
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, etc	571	648
Dust and powder of precious and semiprecious stones	2	--
Grinding and polishing wheels and stones	93	106
Asbestos	15,548	20,868
Barite and witherite	2,806	111
Boron materials:		
Borates and perborates	50	50
Boric acid	2	2
Bromine	84	128
Cement	30,533	2,025
Chalk	271	149

See footnotes at end of table.

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Table 3.—Argentina: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976
NONMETALS —Continued		
Clays and clay products (including all refractory brick):		
Crude:		
Bentonite	4	5
Fire clay	118	61
Kaolin	12,400	16,853
Andalusite, kyanite, sillimanite	r116	124
Other	98	154
Products:		
Refractory (including nonclay brick)	r26,316	24,719
Nonrefractory	3,428	3,724
Cryolite and chiolite	34	14
Diamond:		
Industrial value, thousands	$1,807	$762
Powder thousand carats	151	190
Diatomite and other infusorial earth	2,351	3,027
Feldspar and fluorspar	--	200
Fertilizer materials:		
Crude:		
Nitrogenous	6,436	7,195
Phosphatic	7,750	8,756
Manufactured:		
Nitrogenous	6,085	7,541
Phosphatic	20,174	3,865
Potassic	5,628	13,329
Mixed	15,724	30,432
Ammonia	1	(1)
Graphite, natural	488	424
Iodine	57	108
Magnesite	21,036	24,738
Mica:		
Crude, including splittings and waste	48	20
Worked, including agglomerated splittings	15	12
Pigments, mineral:		
Natural, crude	(1)	--
Iron oxides, processed	275	110
Precious and semiprecious stones, except diamond thousand carats	r3,770	r30,670
Pyrite	30	56
Salt and brines	12	9
Sodium and potassium compounds, n.e.s.:		
Caustic soda	84,119	72,517
Caustic potash, sodic and potassic peroxides	741	511
Sodium carbonate, natural and manufactured (soda ash)	178,746	190,800
Stone, sand and gravel:		
Dimension:		
Crude and partly worked	2,052	1,184
Worked	20	(1)
Dolomite, chiefly refractory grade	3,704	4,282
Gravel and crushed rock, n.e.s	102,959	26,177
Quartz and quartzite	529	188
Sand, excluding metal bearing thousand tons	65	44
Sulfur:		
Elemental:		
Other than colloidal	97,221	105,745
Colloidal	69	130
Sulfuric acid	7	17
Talc, steatite, soapstone, pyrophyllite	489	328
Other nonmetals, n.e.s.:		
Crude	708	3,828
Slag, dross, and similar waste, not metal bearing, from iron and steel manufacture	15	22
Oxides, hydroxides, peroxides of strontium, barium, magnesium	r226	161
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	(2)	--
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	106	61
Carbon black	567	771
Coal, all grades, including briquets thousand tons	1,030	807
Coke and semicoke do	6	1
Hydrogen and rare gases kilograms	r5,221	863
Peat	125	12
Petroleum:		
Crude and partly refined thousand 42-gallon barrels	16,205	22,066
Refinery products:		
Gasoline do	409	31
Kerosine do	376	(1)
Distillate fuel oil do	3,157	3,248
Residual fuel oil do	125	948
Lubricants do	r144	253

See footnotes at end of table.

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Table 3.—Argentina: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976
MINERAL FUELS AND RELATED MATERIALS —Continued		
Petroleum —Continued		
Refinery products —Continued		
Other:		
Liquefied petroleum gas ---- thousand 42-gallon barrels	20,281	17,229
Nonlubricating oils, n.e.s ---- do	1	1
Other ---- do	r83	156
Total ---- do	24,576	21,866
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	r58,155	72,456

rRevised.
[1]Less than 1/2 unit.
[2]Revised to zero.

COMMODITY REVIEW

METALS

Aluminum.—Aluminios Argentinos S.A. (ALUAR), one of the main aluminum companies, was taken over by the military Government. The Argentine Air Force named an official trustee to run the company. By law, the Air Force supervises aluminum production in Argentina because of its important use in production of aircraft.

Kaiser Aluminum and Chemical Corp. agreed to sell its aluminum and refractory production facilities in the Buenos Aires area to a group of Argentine investors for an undisclosed amount of cash.

Argentina's first smelter, operated by ALUAR, increased its capacity from 50,000 tons to 62,500 tons per year of aluminum. Full capacity of up to 140,000 tons was expected by the revised date of 1979, with subsequent expansion to 210,000 tons by 1982.

Copper.—Compañía Minera Aguilar S.A. (CMA), a subsidiary of St. Joe Minerals Corp., continued construction of a permanent access road to the El Pachón copper ore deposit in San Juan Province. In early 1977, CMA initiated negotiations with the Government, but by yearend, no agreement had been reached covering development of the $940 million project. The Governor of San Juan Province made a grant of 1,500 hectares of land to CMA for the El Pachón mine-mill-smelter to treat the copper-molybdenum ore. The company is to set up a township for 2,500 people at Los Erizos, about 13 kilometers from El Pachón and a second township for 3,000 people at Calingasta where the smelter will be located.

CMA was waiting for the mining promotion law to finalize the legal basis of the El Pachón project before going ahead.

Yacimientos Mineros de Agua de Dionisio (YMAD) continued with its prefeasibility on the Bajo La Alumbrera copper-molybdenum-gold project that was expected to be completed in August 1978. An additional 1-year feasibility study was planned.

Iron Ore.—Construction of the offshore shiploading terminal at Punta Colorada for the Sierra Grande iron ore complex in Rio Negro Province was completed in May. The Punta Colorada terminal, built by a West German-Argentine consortium, is the first variable-orientation open-sea bulk terminal in the world. The preconcentration plant for the Sierra Grande underground mine was being constructed by a Japanese group.

In 1977, Argentina's steel industry consumed 2.4 million tons of iron ore, mostly sinter and pellets, of which 1.7 million tons were imported. It was estimated that 3 million tons of iron ore imports would be needed in 1978, probably from Brazil, Chile, and Peru.[3]

Iron and Steel.—Production of crude steel increased 11% in 1977 to a historic high of 2.7 million tons. With apparent consumption of steel estimated at 3.9 million tons, Argentina had the highest per capita consumption of steel in Latin America of 150 kilograms per person, compared with 553 kilograms per person in the United States.[4] Exports of steel products amounted to 230,000 tons valued at $95 million in 1977, compared with 356,000 tons valued at $117 million in 1976. Steel imports of 965,000 tons were valued at $360 million.

Gurmendi S.A. was planning to construct a direct reduction plant with a capacity of 400,000 tons per year of sponge iron. The $75 million plant would be located in Campana District on Río Paraná, 87 kilome-

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ters northwest of Buenos Aires.

SIDERSUR was conducting feasibility studies for a $183 million direct-reduction plant in San Antonio Este, Río Negro Province, with a capacity of 410,000 tons per year planned for a 1983 startup.

As part of Argentina's national iron and steel plan, Siderúrgica Integrada S.A. (SIDINSA), created in 1975, completed the detailed engineering phase of its $3.5 billion project to construct an integrated steel complex in the coastal city of Bahía Blanca, Buenos Aires Province. The steelplant is designed to produce 3.8 million tons of steel products per year, with an eventual capacity of 8 million tons per year. By 1988, the plant would supply 50% of Argentina's demand for hot- and cold-rolled coils and sheets. The project was to be executed in four phases, the first of which was estimated to cost $720 million and was scheduled to be completed in 1983. The project was granted a Government waiver on duties on imported equipment and certain tax benefits.

During 1977, Argentina invested $222 million in the steel industry, mostly in laminated products, representing about 8% of the total investment in steel in Latin America.

Consumption of ferroalloys in 1977 increased 10% to 50,506 tons but remained below the 62,500 tons consumed in 1975.

Table 4.—Argentina: Iron and steel production

(Thousand metric tons)

	1975	1976	1977[1]	Percent change from 1976
Iron, primary:				
Pig iron	1,043	1,280	1,100	-14
Direct reduced iron	--	30	285	+950
Total	1,043	1,310	1,385	+6
Steel:				
Crude[2]	2,243	2,449	2,720	+11
Hot rolled:				
Nonflat:				
Reinforcing bars	507	359	419	+17
Wire rod	300	284	265	-7
Other bar	267	233	261	+12
Structural shapes	174	194	133	-31
Seamless tubes	143	152	203	+34
Other	97	38	35	-8
Total	1,488	1,260	1,316	+4
Flat:				
Sheet[3]	1,454	1,115	1,488	+33
Strip	50	52	54	+4
Total	1,504	1,167	1,542	+32
Total hot rolled	2,992	2,427	2,858	+18
Cold rolled:				
Sheet	755	700	857	+22
Strip	27	19	21	+11
Tin plate	60	69	79	+14
Total	842	788	957	+21

[1]Provisional data.
[2]Includes steel castings produced by Cámara de Industriales Fundidores.
[3]Hot-rolled sheets and coils, including those sold for cold rolling.

Source: Centro de Industriales Siderúrgicos. Annual Report 1977, p. 5.

Lead and Zinc.—St. Joe reported in its 1977 annual report that output by CMA of lead-silver concentrate increased slightly to 46,707 tons and that of zinc concentrate decreased 4% to 85,723 tons. Argentina's smelter capacity was 66,000 tons per year for lead and 52,000 tons per year for zinc. According to a report of the Director Nacional de Economía Minera, Argentina in 1976 was 96% self-sufficient in zinc and 89% self-sufficient in lead.[5] Toward yearend 1977, the Government issued a decree permitting the export of 5,000 tons of electrolytic zinc or alloy through December 31, 1977.

Manganese.—Although Argentina was the second largest producer of manganese

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ore in South America after Brazil, its output was relatively small. YMAD continued development of the Farallón Negro mine and plant in Catamarca Province with mine production scheduled for the revised date of mid-1978. The mine's planned annual production is 40,000 tons of 42% manganese concentrate, 19,600 troy ounces of gold, and 95,000 troy ounces of silver. In 1976, Argentina imported 67,263 tons of manganese concentrate valued at $6.3 million, of which 90% was from Brazil and the remainder from Bolivia, Australia, and India.

Molybdenum.—The most important discovery during 1977 of the Servicio Minero and DGFM was of molybdenum at Famatina in La Rioja Province. The deposit reportedly covers 35 square kilometers. Servicio Minero continued to study the prospect to obtain information needed to stimulate interest by domestic or international private mining companies. Argentina's molybdenum requirements were met by imports that in 1976 amounted to 18.6 tons. This dependency was not expected to change until the Pachón copper project comes into production.

Silver and Tin.—In late 1977, apparently large volumes of disseminated tin and associated high silver values were discovered on the property of Perquitas. Perquitas is located in La Puna District of Jujuy Province near Bolivia and is the only operating tin mine in Argentina. The inferred reserves of the deposit were estimated at 1 million tons of ore. The ore body was considered appropriate for open pit mining, and a mining and milling operation were contemplated. Argentina's measured, indicated, and inferred tin reserves were estimated at less than 30,000 tons fine tin content.

Other.—Argentina was dependent on imports for other metals considered to be of critical importance such as chromium, cobalt, mercury, nickel, platinum, and vanadium. Imports of these commodities required about $7 million per year.

NONMETALS

Boron Minerals.—Production of borates, Argentina's chief mineral export other than petroleum, increased 19% in 1977. In this same year, exports of sodium and calcium borate amounted to $6.3 million and were shipped primarily to Brazil.

Minera Simon Grandinetti Asociados S.A. was arranging for mining and processing facilities to extract borates from the Laguna de Guayatayoc 4,000 meters above sea level, in Jujuy Province. The area is located 250 kilometers from Boroquímica SAMICAF's borate operation on the edge of Salar del Hombre Muerto. The boron mineralization is largely ulexite, a hydrous sodium and calcium borate, which constitutes nearly 50% of the beds. Reserves were estimated at over 620,000 tons of ulexite with a B_2O_3 content of 30% to 35%.

Cement.—Argentina was the third largest cement producer in Latin America after Brazil and Mexico. A group of Spanish companies was studying a $76 million project to install a 625,000-ton-per-year cement plant in Salta Province to exploit a limestone deposit there. The results of the study are not yet known.

MINERAL FUELS

Coal.—Argentina continued to rely entirely on imports to meet its needs for metallurgical coal. In line with the strong increase in crude steel production, imports of metallurgical coal in 1977 increased 27% to 1.1 million tons.

State-owned Yacimientos Carboníferos Fiscales (YCF) was planning to increase production at its Río Turbio-Gallegos complex in Santa Cruz Province from 650,000 tons to 3 million tons per year by 1983. YCF awarded a contract to increase the capacity of the Río Turbio washery-coal grading plant from 500 tons (with a recovery rate ranging from 40% to 70%) to 700 tons per hour. Bids were expected to be called for a new plant with a 1,000-ton-per-hour capacity. Improvements would be required on the railroad to the Port of Río Gallegos and on the port itself, which has a handling capacity of 1 million tons per year. A degasification or briquetting plant was also under consideration.

Total reserves of subbituminous coal at Río Turbio were estimated at 550 million tons of which 285 million tons are measured reserves. Another 40 million tons of coal was reported to lie in adjacent Chilean territory.

Natural Gas.—As shown in table 5, Argentina continued to increase its production and imports of natural gas to meet the country's growing needs. In January, Argentina and Bolivia agreed to increase the price of dry gas in five quarterly increments, from $0.93 to $1.20 per thousand cubic feet by April 1978. Although natural gas and petroleum accounted for only 25% of Argentina's energy reserves, they represented 87% of the country's energy consumption in 1976. In that year, 15% of the natural gas consumed was supplied by im-

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ports. Production of natural gas and petroleum represented 1.2% of the country's GDP.

Construction work continued on the new 205-kilometer gas pipeline to Cerro Redondo, Santa Cruz Province, to utilize the rich gas reserves in the National Territory of Tierra del Fuego. Completion of the gasline was scheduled for mid-1978. In 1977, the Inter-American Development Bank approved another loan of $36 million to Argentina's gas fuel agency, Gas del Estado, to expand the capacity of the southern trunk gas pipeline between Cerro Redondo and Pico Truncado from 35 million cubic meters to 48 million cubic meters per day. The additional gas would save Argentina an estimated $117 million in oil imports each year.

At yearend, Argentina's total proven gas reserves were estimated at 12 trillion cubic feet, compared with 6.7 trillion cubic feet reported for 1976.[6]

Table 5.—Argentina: Production and imports of natural gas

(Million cubic feet and U.S. dollars)

Year	Production marketed	Percent change from previous year	Imports			
			Quantity	Percent change from previous year	Value	Percent change from previous year
1973	244,376	+14	55,444	+56	18.4	+84
1974	264,859	+8	52,513	-5	29.6	+61
1975	271,639	+3	55,691	+6	43.2	+46
1976	272,288	+0	67,663	+21	66.5	+54
1977	278,000	+2	78,982	+17	89.0	+34

Petroleum.—In 1977, Argentina ranked as the third largest oil producer in Latin America after Venezuela and Mexico. Production of crude oil, first discovered in 1907 in Argentina, increased 8% but did not reach the high level of 1972, when Argentina was 94% self-sufficient. Argentina's self-sufficiency increased 2% to 88% in 1977. The State oil company YPF accounted for 76% of total crude output; YPF contracts accounted for 23% of all contracts and 1% of all concessions.[7] The Provinces of Mendoza, Chubut, and Santa Cruz were the main crude oil producers contributing 63% of the Nation's total.

In April, YPF changed its status from that of a Government dependency to that of an autonomous State enterprise.

Argentina was expanding its drilling program as a step toward its goal of gaining self-sufficiency in oil by 1985. During 1977, a total of 680 wells were drilled, compared with 503 wells in 1976. Of the total, 414 wells were capable of producing oil and 34 wells were suitable for gas production. The most significant oil discoveries in 1977 were at Ramos (San Martín Province), Huemul (Santa Cruz Province), and in Chubut Province. YPF was offering service contracts to provide for secondary recovery in the producing areas which in 1977 accounted for only 10% of total output. In October, international bidding was initiated for onshore and offshore oil exploration, especially in the zone of Tierra del Fuego. The call for bids was to expire in January 1978, and operations were to be conducted under "association contracts."

A major petrochemical complex was under development at Bahía Blanca consisting of 10 plants producing ethylene and its derivatives for industry. In 1977, the Inter-American Development Bank approved two loans totaling $105 million to Petroquímica Bahía Blanca S.A.I.C. to expand the company's capacity from 120,000 tons to 202,000 tons per year of ethylene and to help build three byproduct plants for polyethylene, polyvinyl chloride, and caustic soda.

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Table 6.—Argentina: Production and trade of crude petroleum and petroleum products

(Million 42-gallon barrels and U.S. dollars)

Year	Production	Imports		Petroleum products	
		Quantity	Value	Import value	Export value
1970	143.4	10.6	31	7	44
1971	154.5	16.0	51	8	47
1972	158.5	10.9	34	5	20
1973	153.7	21.4	115	5	55
1974	151.1	21.6	343	8	101
1975	144.4	16.2	219	15	156
1976	145.6	22.1	298	18	195
1977	157.3	21.4	298	25	200

Uranium and Nuclear Energy.—Production of yellow cake (U_3O_8) increased substantially in 1977 to 1,492 tons because of the expansion of Don Otto concentration plant near the San Carlos deposit in Salta Province and the startup of the Puesto de Los Adobes plant in Chubut Province, located near the Cerro Cóndor uranium deposit. The yellow cake was further processed to 116 tons of uranium concentrate in a more advanced form. Uranium ore at Puesto de Los Adobes was estimated at 90,000 tons. As reported by the Comisión Nacional de Energía Atómica (CNEA), Argentina has proven uranium reserves of 23,785 tons U_3O_8 and potential reserves of 925,000 tons U_3O_8.

CNEA continued development of the $72 million open pit mine and plant project at Sierra Pintada, Mendoza Province. The first uranium ore from the Tigre III deposit at Sierra Pintada was delivered to CNEA's Malargüe concentration plant in December 1975. This development project was expected to be ready in 1983. Certain United States and European firms have offered to finish the feasibility study started by Siemens of Canada.

With the signing in March of the cooperation agreement with Peru, Argentina became Latin America's first exporter of nuclear energy technology. Construction continued on the civil works for CNEA's second atomic powerplant of 600-megawatt capacity at Río Tercero, Córdoba Province, by Atomic Energy of Canada Ltd. The second Candú nuclear plant was expected to be ready in 1981. By yearend, no decision had been reached on construction of the heavy-water natural uranium reactor of 685-megawatt capacity, Atucha No. 2, to be sited near the Atucha No. 1 center. By 1980 the small heavy water pilotplant at the Atucha atomic center and the new fuel production plant at the Ezeiza atomic center were expected to be ready. By 1983 Argentine industry was expected to produce an ample supply of zirconium sponge from domestic sources for the cladding of the fuel elements.

[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Argentine pesos to U.S. dollars at the 1977 average rate of M$N438 = US$1.00. At yearend the rate was M$N600 = US$1.00.

[3]Siderurgia Latinoamericana. No. 216, April 1978, p. 32.

[4]Centro de Industriales Siderúrgicas. 1977 Annual Report, p. 10.

[5]Secretaria de Estado de Minería, Dirección Nacional de Economia Minera. Las Sustancias Minerales Críticas para la Defensa y Seguridad Nacional (Buenos Aires). 1977, p. 25.

[6]Oil and Gas Journal. V. 76, No. 52, Dec. 25, 1978, p. 103.

[7]Instituto Argentino del Petróleo. Comisión de Estadisticas. Resumen de la Actividad Petrolera. January/December 1977.

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The Mineral Industry of Australia

By Charlie Wyche[1]

In 1977, the Australian mineral industry maintained a satisfactory level of performance despite depressed world demand for certain mineral commodities. Prices of some commodities declined, and there were significant stock accumulations, but output of most minerals exceeded the 1976 figures. Although world prices were at lower levels, planning and development proceeded for a number of major copper, lead, zinc, nickel, and petroleum projects in New South Wales and Western Australia. There was also considerable interest in uranium mining, and Australia could become a major world supplier of uranium oxide (U_3O_8) by 1985.

The value of mine and quarry production reached a record high of $4.5 billion,[2] an increase of nearly 10% more than the $4.1 billion reported for 1976. The $5.2 billion value added by domestic smelting and other processing of mineral commodities credited the mineral industry with products valued at $9.7 billion. This figure represents 10% of the $96 billion adjusted gross national product (GNP).

The Government provided an investment allowance, reduced the coal export levy, raised the controlled price for domestic crude oil to world parity, and provided tax concessions for offshore oil exploration. A controversial but important decision made in 1977 was to allow uranium mining to proceed. The Government also passed the Aboriginal Land Rights Act, which safeguards the territorial and cultural rights of aborigines in the uranium-rich Northern Territory.

Although the rate of inflation declined from 13.4% to 9.3% during the year, the economy remained somewhat slack, and the return of business confidence was slow. This hindered the availability of risk capital within Australia. Since a large proportion of capital used for mineral exploration in recent years has been from overseas, the level of exploration continued to increase. In 1977, private exploration expenditures totaled $134 million compared with $114 million in 1976. Nearly 50% of these expenditures were in Western Australia.

PRODUCTION

Both mine and smelter production increased for most commodities. However, depressed demand resulted in the closure or suspension of operations at some copper and nickel mines and cutbacks in planned production at manganese, phosphate, and iron ore operations. Although another gold mine closed, commencement of production at a major new mine led to an increase in domestic gold output after many years of decline. Increased production of lead resulted in a buildup of coproduct zinc stocks.

Production of mineral sands declined significantly when compared with production for recent years owing to the cessation of mining on Fraser Island and in the Double Island Point area. Prices for rutile, and especially for zircon, were also down. Significant programs of expansion and development of mines were implemented by some coal and iron ore producers.

Western Australia strengthened its position as the country's largest mineral-producing State, accounting for 38% of the

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total value of mineral output in 1977. The value of minerals produced totaled $1.7 billion, a 13% increase over that of 1976, which was largely owing to increased production of iron ore, alumina, gold, coal, and crude oil. The value of iron ore shipments increased from $841 million to $951 million. The value of alumina production increased $27 million to $276 million. Values of $45.6 million for gold and $23.1 million for coal also contributed significantly to the total increased mineral value.

The value of mineral production in Queensland, the second largest mineral-producing State, totaled $1.25 billion, compared with $1.14 billion in 1976, which represented 28% of the total value of national mining sector output. Production value of certain minerals decreased slightly and increased output was recorded by others. Coal and copper, which earned $687 million and $181 million, respectively, were the principal contributors. Other significant minerals mined in Queensland were bauxite ($77 million), lead ($73 million), zinc ($67 million), silver ($52 million), and mineral sands ($17 million).

New South Wales' output of coal, lead, zinc, mineral sands, and silver ranked the State as the third largest mineral producer, with 18% of the national mining sector total value. Victoria, the only brown coal producing State, was fourth with 13%. South Australia, Tasmania, and the Northern Territory, which produced such commodities as iron ore, bauxite, tin, and copper, accounted for the remainder.

Table 1.—Australia: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Aluminum:			
Bauxite, gross weight thousand tons	21,003	24,084	26,070
Alumina do	5,129	6,206	6,659
Metal, refined do	214	232	248
Antimony, mine output (content of antimony and lead concentrates)	2,205	1,892	1,584
Bismuth, mine output, metal content	844	749	912
Cadmium:			
Mine output, metal content	1,613	1,533	1,580
Smelter output (refined)	549	649	653
Cobalt, mine output (content of zinc and nickel concentrates)	2,709	3,250	3,295
Columbium-tantalum concentrates, gross weight[1]	132	124	158
Copper:			
Mine output, metal content	218,961	218,480	219,938
Smelter:			
Primary	180,037	167,346	167,373
Secondary	[r]2,546	2,977	4,018
Refined:			
Primary	165,770	160,317	154,714
Secondary	[r]12,140	15,256	14,461
Gold:			
Mine output, metal content troy ounces	526,821	502,740	622,663
Refined (excluding recovery from scrap) do	481,682	471,844	552,413
Iron and steel:			
Iron ore, gross weight thousand tons	97,651	93,255	96,098
Metal:			
Pig iron do	7,475	7,417	6,753
Ferroalloys:[2]			
Ferrochromium, high-carbon	1,611	--	--
Ferromanganese, high-carbon	38,784	49,927	[e]60,000
Ferrosilicon	247	5,399	[e]15,000
Silicomanganese	11,197	14,651	[e]15,000
Total	51,939	69,977	[e]90,000
Steel:			
Crude thousand tons	7,843	7,774	7,313
Semimanufactures do	5,914	5,957	6,743
Lead:			
Mine output, metal content	407,801	397,403	433,646
Metal:			
Primary:			
Bullion, for export	151,520	160,690	155,211
Refined	159,793	181,941	179,759
Total	311,313	342,631	334,970
Secondary (excluding remelt)[e]	[r]33,700	[r]29,600	37,700
Manganese ore, gross weight thousand tons	1,555	2,154	1,387

See footnotes at end of table.

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Table 1.—Australia: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS —Continued			
Mercury 76-pound flasks	6	4	1
Molybdenum, mine output, metal content	([3])	([3])	--
Nickel:			
Mine output, metal content	75,825	82,532	84,309
Metal, refined	36,300	46,000	[e]46,000
Platinum-group metals:[4]			
Palladium, metal content troy ounces	3,478	7,950	[e]12,000
Platinum, metal content do.	1,446	3,158	
Ruthenium do.	181	462	
Total do.	5,105	11,570	[e]12,000
Rare-earth minerals: Monazite concentrate, gross weight	4,507	5,310	10,633
Silver:			
Mine output, metal content thousand troy ounces	23,348	25,034	27,424
Refined do.	8,972	8,187	8,239
Tin:			
Mine output, metal content	9,577	10,611	9,968
Refined:			
Primary	5,254	5,603	5,561
Secondary	396	255	205
Titanium concentrates, gross weight:			
Ilmenite thousand tons	991	959	1,070
Leucoxene	16,871	12,223	10,704
Rutile	348,350	389,750	324,371
Tungsten, mine output, metal content	1,497	1,989	2,333
Zinc:			
Mine output, metal content	500,846	468,586	491,756
Smelter:			
Dust	6,453	6,737	[e]7,000
Primary	193,310	242,635	248,843
Secondary[e]	7,000	6,600	6,600
Zirconium concentrate, gross weight	382,217	420,185	397,425
NONMETALS			
Abrasives, natural:			
Beach pebble	872	1,547	NA
Garnet (sales)	1	95	1,104
Asbestos	47,922	60,642	49,420
Barite	23,460	14,133	11,665
Cement, hydraulic thousand tons	5,017	5,062	5,023
Clays:			
Bentonite and bentonite clay	[r]3,350	11,954	[e]12,000
Brick clay and shale thousand tons	7,816	9,431	8,963
Cement clay and shale	550	441	NA
Damourite clay (sales)	1,348	1,334	NA
Fire clay thousand tons	340	337	NA
Fuller's earth	18	9	[e]9
Kaolin and ball clay	80,674	69,303	[e]69,000
Other[5] thousand tons	526	425	NA
Diatomite	5,543	1,480	1,145
Feldspar	3,054	4,519	1,677
Fertilizer materials:			
Crude, phosphate rock	123,883	275,600	409,944
Manufactured, phosphatic (P_2O_5 content) thousand tons	1,593	2,814	3,385
Gem stones value, thousands	$47,970	$73,720	NA
Gypsum thousand tons	933	942	900
Lime[6]	883,636	902,210	[e]902,000
Magnesite	16,208	14,706	18,509
Perlite, crude	3,347	3,448	NA
Pigments, natural mineral, ocher	--	1,025	NA
Pyrite, including cupreous, gross weight	225,015	216,749	225,270
Salt thousand tons	[r]4,660	5,489	[e]6,000
Sand and gravel:			
Construction sand[5] do.	24,412	24,264	NA
Gravel[5] do.	16,181	15,640	NA
Stone:			
Dolomite do.	450	589	542
Limestone:			
For cement do.	[r]8,034	7,673	[5]9,289
For other uses do.	[r]2,820	2,910	NA
Silica in the form of quartz, quartzite, and glass sand do.	1,219	1,381	NA
Other:			
Crushed and broken do.	58,213	53,033	NA
Dimension[7] do.	255	112	NA
Unspecified[8] do.	35,416	32,805	NA

See footnotes at end of table.

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Table 1.—Australia: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
NONMETALS —Continued				
Sulfur:				
Byproduct[9]	thousand tons	441	423	445
Sulfuric acid (from source materials)	do	1,151	1,582	1,741
Talc, soapstone, pyrophyllite		82,387	92,097	126,640
MINERAL FUELS AND RELATED MATERIALS				
Coal:				
Bituminous and subbituminous	thousand tons	67,019	74,853	78,284
Lignite	do	28,178	30,940	29,293
Total	do	95,197	105,793	107,577
Coke:				
Metallurgical	do	5,239	5,310	4,670
Gashouse (including breeze)	do	[e]r55	[e]50	NA
Total	do	r5,294	5,360	4,670
Fuel briquets	do	1,030	959	941
Gas, natural, marketed production	million cubic feet	177,491	209,380	237,596
Natural gas liquids:[10]				
Ethane	thousand 42-gallon barrels	723	961	[e]1,000
Propane	do	6,705	7,252	16,676
Butane	do	7,576	8,116	NA
Condensate	do	44	39	[e]40
Total	do	r15,048	16,368	17,716
Peat		4,800	4,449	3,197
Petroleum:				
Crude	thousand 42-gallon barrels	149,880	152,522	157,157
Refinery products:				
Gasoline:				
Aviation	do	252	297	333
Motor	do	78,220	79,960	86,875
Jet fuel	do	13,844	13,186	14,001
Kerosine	do	1,233	2,066	2,069
Distillate fuel oil	do	50,545	51,891	55,715
Residual fuel oil	do	29,820	30,704	29,380
Lubricants	do	2,440	3,358	3,573
Other:				
Refinery gas[11]	do	742	727	711
Liquefied petroleum gas	do	4,082	4,071	4,522
Solvents	do	1,258	1,455	1,472
Bitumen	do	2,830	2,911	3,340
Unspecified	do	8,680	8,389	6,756
Refinery fuel and losses	do	15,234	16,467	16,944
Total	do	209,180	215,482	225,691

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]Exports (production not officially reported).

[2]Data are for year ending November 30 of that stated for plants owned by The Broken Hill Pty. Co. Ltd.

[3]Revised to none.

[4]Western Australia only. Content of nickel ore.

[5]Excludes production from Western Australia.

[6]Data are for years ending June 30 of that stated.

[7]Excludes production from Northern Territory and Australian Capital Territory.

[8]Excludes production from Northern Territory, Australian Capital Territory, and Western Australia.

[9]Sulfur content of materials obtained as a byproduct of nonferrous metallurgical operations and oil refining.

[10]Excludes production of natural gas liquids (natural gasoline and liquefied petroleum gas) from Barrow Island, off of the Western Australian coast. An unspecified portion of the liquefied petroleum natural gas extracted is apparently marketed locally, but this quantity is limited. The bulk of the liquefied petroleum gas and all of the natural gasoline is blended with crude oil and presumably counted with crude oil from that area. Gross production of natural gas liquids on Barrow Island was as follows, in thousand barrels: liquefied petroleum gas: 1975—21,977, 1976—21,657, 1977—NA; natural gasoline: 1975—17,418, 1976—21,058, 1977—NA. Natural gas liquid output from several gasfields in Western Australia is excluded for similar reasons. Condensate production from these fields was as follows in thousand barrels: 1975—31, 1976—25, 1977—NA.

[11]Residual fuel oil equivalent.

TRADE

Increased exports and higher prices of most major minerals resulted in a record high export value. The value of exports of primary mineral products was $4.7 billion, an increase of 17% over that of 1976. For the first time in Australia's history, coal

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brought more money in export earnings than wool. Australia's exports of coal were valued at $1.4 billion, iron ore and pellets at $952 million, and alumina at $629 million. Significant export values of $252 million, $231 million, and $150 million were reported for nickel, lead, and zinc, respectively.

The value of mineral imports increased to $912 million, 26% higher than in 1976. Crude oil accounted for $717 million, 79% of total mineral import value. The other principal import categories were phosphate rock, asbestos, and diamond, with values of $48 million, $34 million, and $24 million, respectively.

Table 2.—Australia: Exports and reexports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1974-75	1975-76	Principal destinations, 1975-76
METALS			
Aluminum:			
Bauxite, gross weight	7,900	7,356	Japan 2,717; West Germany 2,239; Italy 1,384.
Alumina, gross weight thousand tons	4,562	5,226	NA.
Metal:			
Scrap	1,721	3,922	Japan 3,207; Netherlands 240; Taiwan 173.
Unwrought	64,065	69,074	Japan 50,330; China, People's Republic of, 5,006; Philippines 4,468.
Semimanufactures	6,128	1,631	Malaysia 336; Papua New Guinea 216; Indonesia 183.
Antimony ore and concentrates, gross weight	1,756	1,632	Belgium-Luxembourg 1,186; West Germany 173.
Beryllium ore and concentrate, gross weight	99	--	
Cadmium metal, refined, unwrought, and semimanufactures	430	604	United States 500; United Kingdom 73.
Chromium:			
Chromite ore and concentrate, gross weight	44	66	New Zealand 35; Singapore 12; Malaysia 10.
Chromium oxides and hydroxides	30	2	New Zealand 2.
Columbium and tantalum, columbite-tantalite concentrate, gross weight	123	140	Japan 67; United States 49; Netherlands 21.
Copper:			
Ore and concentrate, gross weight	146,970	161,794	Japan 155,416; Belgium-Luxembourg 2,503; West Germany 1,947.
Matte	5,849	4,909	Netherlands 3,696; Republic of South Africa 1,213.
Metal including alloys:			
Copper-lead dross and speiss	4,681	3,496	United States 3,478; Denmark 17.
Copper slags and residue	6,778	22,143	Singapore 22,121.
Scrap including alloy scrap	432	554	Japan 228; United Kingdom 152; United States 55.
Unwrought:			
Blister and cement	15,136	9,497	Japan 8,183; United Kingdom 982.
Other, unalloyed	93,862	85,801	West Germany 24,853; United Kingdom 20,733; France 12,882.
Alloyed	12	47	West Germany 36; New Zealand 4.
Semimanufactures:			
Unalloyed	16,986	14,386	New Zealand 9,241; Indonesia 1,863; Malaysia 1,433.
Alloyed	2,006	2,103	Hong Kong 954; New Zealand 364; United States 219.
Gold:			
Ore and concentrate, metal content troy ounces	[2]160,207	[2]122,462	NA.
Metal:			
Mint bullion do.	57,202	227,510	Hong Kong 154,386; West Germany 56,016; Japan 15,983.
Refined and unrefined bullion do.	95,842	5,605	New Zealand 3,530; Hong Kong 1,703; Malaysia 210.
Iron and steel:			
Ore and concentrate thousand tons	85,316	78,931	Japan 62,548; West Germany 3,399; Italy 2,198.
Roasted pyrite	130	120	Mexico 90; Thailand 18; Netherlands 12.
Metal:			
Scrap thousand tons	733	622	NA.
Pig iron and equivalent materials do.	559	593	China, People's Republic of, 420; Romania 58; Poland 42.
Ferroalloys	1,158	449	New Zealand 448.
Steel ingots and other primary forms thousand tons	1,162	2,836	New Zealand 1,149; Spain 322; Argentina 182.

See footnotes at end of table.

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Table 2.—Australia: Exports and reexports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1974-75	1975-76	Principal destinations, 1975-76
METALS —Continued			
Iron and steel —Continued			
Metal —Continued			
Semimanufactures:			
Bars, rods, angles, shapes, sections thousand tons	162	173	China, People's Republic of, 37; Indonesia 30; Belgium-Luxembourg 29.
Universals, plates, sheets ——do——	259	198	China, People's Republic of, 39; Indonesia 35; Papua New Guinea 17.
Hoop and strip ——do——	15	6	New Zealand 5.
Rails and accessories ——do——	4	4	New Zealand 2; Indonesia 1.
Wire ——do——	22	10	New Zealand 6; Fiji 1; Papua New Guinea 1.
Tubes, pipes, and fittings ——do——	112	42	Indonesia 5; Papua New Guinea 3; New Zealand 2.
Castings and forgings, rough ——do——	10	3	United States 1; New Zealand 1.
Total ——do——	584	436	
Lead:			
Ore and concentrate, gross weight	42,192	84,897	United States 31,391; Belgium-Luxembourg 14,681; Greece 11,105.
Slag and residue	25,372	19,340	United States 15,161; Japan 1,607; Belgium-Luxembourg 673.
Oxides	2,811	4,231	Malaysia 1,343; Thailand 837; Singapore 659.
Metal including alloys:			
Scrap including alloy scrap	397	1,421	West Germany 686; Japan 359; Republic of South Africa 300.
Unwrought:			
Lead-silver, bullion, lead content	152,703	151,652	United Kingdom 132,191; Netherlands 14,858.
Refined	124,757	153,675	United Kingdom 40,107; India 32,408; Malaysia 19,780.
Alloys, antimonial and other	4,757	5,625	New Zealand 2,122; Malaysia 1,135; Singapore 864.
Semimanufactures	605	1,846	West Germany 1,264; Singapore 216; Indonesia 97.
Magnesium oxide	323	1,368	United States 1,037; Philippines 128; New Zealand 105.
Manganese ore[3] thousand tons	65	220	New Zealand 220.
Nickel:			
Ore and concentrate value, thousands	$13,396	$10,787	NA.
Matte, speiss, and similar material ——do——	$45,116	$139,510	NA.
Metal including alloys:			
Unwrought ——do——	$66,631	$37,285	NA.
Semimanufactures ——do——	$32,803	$25,484	NA.
Platinum-group metals troy ounces	23,013	25,433	Hong Kong 16,756; New Zealand 5,106; West Germany 2,141.
Rare-earth metals: Monazite concentrate, gross weight	3,684	2,475	France 1,406; United Kingdom 610; West Germany 440.
Silver:			
Concentrate and lead-silver bullion, silver content thousand troy ounces	[2]14,343	[2]10,485	NA
Mint bullion ——do——	4,355	2,699	United Kingdom 1,483; Japan 867; Singapore 221.
Other ——do——	253	194	New Zealand 155; Hong Kong 18; Malaysia 14.
Alloys value, thousands	$803	$1,585	New Zealand $1,135; Hong Kong $151; Singapore $89.
Tin:			
Ore concentrate, gross weight	13,371	8,457	Malaysia 5,477; United Kingdom 2,405.
Oxides	28	15	New Zealand 9; Japan 4; Malaysia 1.
Metal including alloys:			
Unwrought	2,434	2,381	Canada 919; United States 648; United Kingdom 484.
Semimanufactures	548	654	Papua New Guinea 445; New Zealand 110; Argentina 84.
Titanium ores and concentrates, gross weight:			
Ilmenite (excluding beneficiated ilmenite)	628,422	611,251	United Kingdom 164,626; Japan 110,774; France 109,143.
Leucoxene	15,824	8,840	United States 8,217; Belgium-Luxembourg 328.
Rutile	338,037	784,845	United States 609,977; United Kingdom 55,909; Netherlands 33,264.
Tungsten ores and concentrates, gross weight:			
Scheelite	1,914	2,325	West Germany 817; United Kingdom 418; U.S.S.R. 257.
Wolframite	465	546	United Kingdom 210; West Germany 164; Netherlands 69.

See footnotes at end of table.

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Table 2.—Australia: Exports and reexports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1974-75	1975-76	Principal destinations, 1975-76
METALS —Continued			
Uranium and thorium ores and concentrates, excluding monazite	--	26	West Germany 18; Japan 8.
Vanadium ore and concentrate	10,541	711	Spain 300; Italy 178; United Kingdom 72.
Zinc:			
Ore and concentrate, gross weight	403,822	458,987	Japan 188,038; Netherlands 152,457; Belgium-Luxembourg 71,287.
Oxide	1,318	934	Indonesia 519; Philippines 261; India 47.
Metal including alloys:			
Slag and residues	5,536	5,304	Republic of South Africa 1,943; Taiwan 1,391; United Kingdom 720.
Unwrought	140,429	124,068	United States 21,766; Indonesia 19,392; Thailand 14,832.
Semimanufactures	2,856	2,741	New Zealand 1,985; Singapore 283; Taiwan 146; Malaysia 146.
Zirconium ore and concentrate, gross weight, minimum 30% $ZrSiO_4$	388,964	58,211	Japan 15,746; France 14,903; West Germany 8,283.
Other:			
Ore and concentrate of base metals, n.e.s. value, thousands	$118,937	$93,247	NA.
Waste and scrap containing nonferrous metals	18,486	1,179	United Kingdom 338; India 301; Japan 196.
Oxides, hydroxides, peroxides of metals n.e.s. value, thousands	$2,443	$4,672	Sweden $975; United States $903; Taiwan $669.
Metals including alloys, all forms:			
Unwrought and semimanufactures:			
Magnesium, beryllium, and their alloys	345	7	United States 5; New Zealand 1.
Molybdenum, tungsten, and their alloys	4	6	United Kingdom 4; Taiwan 1; Sweden 1.
Base metals, including alloys, all forms value, thousands	$1,069	$669	West Germany $241; Belgium-Luxembourg $119; United States $79.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc ---do---	$172	$78	Japan $51; Thailand $10; Philippines $10.
Dust and powder of precious and semiprecious stones ---do---	$107	$4	New Zealand $3.
Grinding and polishing wheels and stones ---do---	$864	$552	New Zealand $276; Philippines $76; Hong Kong $46.
Asbestos, crude and fiber	15,940	38,139	Malaysia 6,050; Japan 4,880; Iran 3,548.
Barite and witherite	2,690	15,870	Indonesia 11,045; New Zealand 4,596.
Cement, hydraulic	146,614	85,530	Singapore 53,902; Indonesia 19,011; Papua New Guinea 8,876.
Clays and clay products (including all refractory brick):			
Crude clays including fire clay and sillimanite	7,464	5,659	United Kingdom 3,418; Japan 1,927.
Products:			
Refractory:			
Bricks	7,458	2,685	New Zealand 1,380; Indonesia 541; Fiji 222.
Other ---- value, thousands	$931	$795	New Zealand $300; New Caledonia $239; Singapore $87.
Nonrefractory ---do---	$273	$280	United Kingdom $59; New Zealand $45; Papua New Guinea $45.
Diamond:			
Gem, not set or cut ---- carats	6,095	12,815	Israel 3,761; New Zealand 3,302; Belgium-Luxembourg 1,811.
Industrial ---do---	216,267	177,350	Ireland 133,680; Philippines 22,405; United States 12,333.
Fertilizer materials:			
Crude, nitrogenous	18,016	160,782	Japan 89,214; Republic of Korea 43,794; Philippines 19,142.
Manufactured:			
Nitrogenous	7,291	47,934	Republic of South Africa 14,005; Taiwan 11,921; Brazil 10,500.
Phosphatic (excluding basic slag)	918	7,475	Bangladesh 7,100; New Caledonia 104; British Solomon Islands 100.
Potassic	34	--	
Other, including mixed	20,319	154	Papua New Guinea 124; New Zealand 28; Singapore 2.

See footnotes at end of table.

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Table 2.—Australia: Exports and reexports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1974-75	1975-76	Principal destinations, 1975-76
NONMETALS —Continued			
Fertilizer materials —Continued			
Ammonia ____ value, thousands	$15,803	$1,190	United States $558; Philippines $433; New Zealand $177.
Gem stones, except diamond:			
Opals ____ do	$19,072	$17,394	Hong Kong $9,620; Japan $2,477; United States $1,891.
Sapphire ____ do	$3,261	$3,552	Thailand $1,598; Hong Kong $563.
Other ____ do	$1,679	$1,241	Hong Kong $356; United States $306; New Zealand $139.
Gypsum	264,891	306,719	Singapore 138,579; New Zealand 134,873; Indonesia 21,831.
Lime (quicklime, slaked lime, and hydraulic lime)	2,267	1,820	Papua New Guinea 1,792; Norfolk Island 18.
Magnesite	644	29,385	Austria 13,450; Yugoslavia 10,447; Republic of South Africa 5,250.
Mica, worked, and articles ____ value, thousands	$62	$60	New Zealand $48; Indonesia $12.
Pigments, mineral:			
Micaceous iron oxide	26	24	New Zealand 8; Papua New Guinea 7; Western Samoa 5.
Iron oxides, other	116	14	New Zealand 12.
Pyrite, unroasted, gross weight	15	110	New Zealand 104; Indonesia 5.
Salt and brine ____ thousand tons	3,898	4,850	Japan 3,279; Papua New Guinea 1,104; Taiwan 370.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	8,364	26,585	New Zealand 15,254; Taiwan 6,835; Pakistan 2,153.
Caustic potash	104	146	Papua New Guinea 144.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	379	112	Japan 66; New Zealand 41.
Worked ____ value, thousands	$40	$58	Singapore $25; United States $18; New Zealand $10.
Sand, gravel, limestone, flux, other calcareous stone	513,856	389,700	Japan 277,768; New Zealand 48,434; United States 44,546.
Sulfur, sulfuric acid	6,101	173	Papua New Guinea 71; Fiji 46; United Arab Emirates 12.
Talc, steatite, soapstone, pyrophyllite	43,801	58,953	Japan 37,559; Netherlands 14,691; United Kingdom 4,730.
Other nonmetals, n.e.s.:			
Crude			
Quartz, mica, feldspar, fluorspar, cryolite	248	100	New Zealand 92; Japan 6.
Refractory materials, except clay and magnesite	173	340	Papua New Guinea 237; Iran 60; Fiji 19.
Other ____ value, thousands	$85	$187	Singapore $132; Japan $13; United States $8.
Oxides and hydroxides of magnesium, strontium, and barium	306	39	Philippines 36; Indonesia 1.
Building materials of asphalt, asbestos, and fiber cement ____ value, thousands	$9,887	$5,881	Canada $2,054; Bahrain $1,021; Iran $879.
MATERIAL FUELS AND RELATED MATERIALS			
Carbon black	21,180	25,814	Indonesia 8,530; New Zealand 7,824; Malaysia 4,202.
Coal, bituminous and lignite, and peat (including briquets):			
Bituminous coal and briquets ____ thousand tons	32,657	29,224	Japan 22,630; United Kingdom 2,638; France 989.
Lignite, peat, and briquets thereof	40	234	Republic of Korea 137; Nauru 93.
Coke and semicoke	420,875	181,863	West Germany 62,657; Japan 59,656; Netherlands 34,936.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	1,474	1,531	New Zealand 868; Japan 524; Singapore 139.
Refinery products:			
Gasoline ____ do	2,463	1,368	New Zealand 1,101; Fiji 120; Papua New Guinea 101.
Jet fuel ____ do	2,533	1,966	New Zealand 1,320; Fiji 281; Singapore 207.
Kerosine ____ do	635	162	New Zealand 124; Fiji 23; Papua New Guinea 10.
Distillate fuel oil ____ do	2,805	2,644	New Zealand 1,269; Singapore 534; Republic of South Africa 365.
Residual fuel oil ____ do	3,322	5,030	Japan 2,393; United States 1,815; Singapore 573.
Lubricants ____ do	730	650	New Zealand 295; Malaysia 118; Papua New Guinea 58.
Other ____ do	297	195	Mainly to New Zealand.

See footnotes at end of table.

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Table 2.—Australia: Exports and reexports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1974-75	1975-76	Principal destinations, 1975-76
MATERIAL FUELS AND RELATED MATERIALS — Continued			
Mineral tar and other coal-, petroleum-, or gas-derived chemicals value, thousands	$2,685	$9,088	New Zealand $7,408; Japan $710; Belgium-Luxembourg $589.

NA Not available.

[1]Data are for years beginning July 1 and values are in Australian dollars.

[2]Australian Mineral Industry Quarterly, v. 29, No. 1 for quarters ending September and December 1975 and v. 29, Nos. 3 and 4 for quarters ending in March and June 1976 for 1975-1976 data; v. 28, No. 2 for quarters ending September and December 1974 and v. 28, No. 4 for quarters ending March and June 1975 for 1974-75 data.

[3]An unreported amount of manganese ore is included in the category "Ores and concentrates of base metals, n.e.s."

Table 3.—Australia: Imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1974-75	1975-76	Principal sources, 1975-76
METALS			
Aluminum:			
Oxide and hydroxide	9,275	4,626	Japan 2,444; United States 1,303; United Kingdom 374.
Metal including alloys:			
Scrap	1,211	1,585	New Zealand 1,442; Papua New Guinea 95; Kenya 45.
Unwrought	2,847	220	United Kingdom 205; Japan 10; United States 2.
Semimanufactures	9,414	3,977	United States 1,291; Japan 907; United Kingdom 836.
Antimony metal, all forms	203	351	China, People's Republic of, 176; Japan 160; United Kingdom 11.
Arsenic trioxide and pentoxide	1,402	537	France 174; United Kingdom 161; Sweden 116.
Beryllium metal including alloys, all forms value	$1,430	$3,000	Japan $2,000; United States $1,000.
Bismuth metal including alloys, all forms	17	6	United Kingdom 2; Bulgaria 1; Italy 1.
Cadmium metal including alloys, all forms	9	5	Belgium-Luxembourg 4; Spain 1.
Chromium:			
Chromite	39,773	4,302	Philippines 2,500; Republic of South Africa 1,802.
Oxide, hydroxide, and trioxide	879	543	U.S.S.R. 283; West Germany 160; United States 88.
Metal including alloys, all forms	28	37	Japan 25; United Kingdom 12.
Cobalt:			
Oxide and hydroxide	71	21	United Kingdom 10; Canada 10.
Metal including alloys, all forms	41	48	Belgium-Luxembourg 19; Zaire 17; United Kingdom 4.
Copper:			
Ore and concentrate kilograms	57	--	
Copper sulfate	1,090	40,871	New Zealand 40,808; United Kingdom 62; United States 1.
Metal including alloys:			
Scrap:			
Unalloyed	686	484	New Zealand 334; Papua New Guinea 121; Malaysia 16.
Alloyed	2,764	10,019	Papua New Guinea 9,710; New Zealand 250; Fiji 29.
Unwrought	258	55	New Zealand 12; United Kingdom 12; Papua New Guinea 11.
Semimanufactures value, thousands	$7,336	$4,294	United Kingdom $2,136; Japan $1,604; West Germany $233.
Gold:			
Ore and concentrate	45	2	Mostly from Fiji.
Crude bullion, gold content troy ounces	84,795	92,477	Fiji 71,646; Papua New Guinea 20,514; Hong Kong 216.
Refined bullion do	1,252	751	Switzerland 673; Singapore 37.
Iron and steel:			
Ore and concentrate, including roasted pyrite	18,378	34,038	Canada 33,983; Japan 35.
Metal:			
Scrap	492	121,118	Papua New Guinea 121,030.
Sponge iron, powder, and shot	8,702	5,004	Sweden 2,714; Japan 1,479; United Kingdom 408.
Spiegeleisen	24	12	All from West Germany.
Ferroalloys:			
Powder:			
Ferromanganese	325	88	Japan 87; United States 1.
Other	463	260	Japan 92; Republic of South Africa 90; United Kingdom 63.

See footnotes at end of table.

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Table 3.—Australia: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1974-75	1975-76	Principal sources, 1975-76
METALS —Continued			
Iron and steel —Continued			
Metal —Continued			
Ferroalloys —Continued			
Shot:			
Ferrochromium	9,390	4,305	Republic of South Africa 2,850; Japan 1,356; Sweden 38.
Ferromanganese	7,239	2,898	Republic of South Africa 2,405; Japan 401; West Germany 42.
Ferromolybdenum	540	109	United States 89; West Germany 13; United Kingdom 7.
Ferrosilicon	21,578	14,258	Republic of South Africa 6,674; Japan 3,880; Philippines 2,002.
Ferronickel	1,563	434	All from New Caledonia.
Other	1,697	2,648	United Kingdom 2,093; Japan 177; France 164.
Steel, primary forms	136,440	8,465	Japan 8,213; United Kingdom 111; United States 67.
Semimanufactures:			
Bars, rods, angles, shapes, sections	91,236	107,873	Japan 94,397; United Kingdom 5,762; Sweden 1,573.
Universals, plates, sheets	288,701	207,336	Japan 187,418; West Germany 9,468; United Kingdom 3,164.
Hoop and strip	40,767	24,011	Japan 18,774; United Kingdom 2,502; Sweden 975.
Rails and accessories	19,230	18,256	Japan 17,916; United Kingdom 179; U.S.S.R. 110.
Wire	63,967	8,953	Japan 5,360; United Kingdom 964; France 603.
Tubes, pipes, fittings[2]	90,335	67,436	Japan 42,245; United Kingdom 5,495; Republic of Korea 5,472.
Castings and forgings, rough value, thousands	$204	$348	United States $244; United Kingdom $85; New Zealand $6.
Lead:			
Oxides	91	19	Republic of South Africa 10; United Kingdom 7; United States 2.
Metal including alloys:			
Scrap	160	233	New Zealand 68; Papua New Guinea 29; Singapore 15.
Unwrought and semimanufactures	119	50	New Zealand 22; Canada 9; United Kingdom 5.
Magnesium metal including alloys, all forms	2,749	928	United States 486; U.S.S.R. 475; Canada 96.
Manganese:			
Ore and concentrate:			
Battery grade	2,581	1,007	All from the United States.
Metallurgical grade	171	243	United States 177.
Oxides	1,396	1,109	United States 960; Japan 114; India 33.
Metal including alloys, all forms	1,197	858	Republic of South Africa 774; France 68; Japan 16.
Mercury 76-pound flasks	1,456	1,771	China, People's Republic of, 711; Spain 531; U.S.S.R. 381.
Molybdenum:			
Ore and concentrate	642	24	Canada 19; United States 5.
Metal including alloys, all forms:			
Wire	6	7	United States 5; United Kingdom 2.
Other value, thousands	$84	$36	United States $30; United Kingdom $2.
Nickel:			
Matte, speiss, and similar materials	--	1,444	Canada 1,444.
Metal including alloys:			
Scrap	16	69	Taiwan 36; Hong Kong 22; New Zealand 11.
Unwrought	2,191	1,147	Canada 1,107; Republic of South Africa 16; Japan 14.
Semimanufactures	2,023	1,565	Japan 544; United States 503; United Kingdom 308.
Platinum-group metals and silver:			
Ore and concentrate	8	8	All from Fiji.
Waste and sweepings value, thousands	$1,132	$747	Hong Kong $458; New Zealand $174; Malaysia $62.
Metals including alloys:			
Platinum-group troy ounces	20,885	48,765	United States 27,678; United Kingdom 9,363; Netherlands 6,393.
Silver containing 75% or more silver, silver content do	38,053	32,675	Fiji 28,195; United Kingdom 3,261; West Germany 1,012.
Silicon metal	2,602	1,845	Republic of South Africa 1,512; Italy 150; Norway 61.

See footnotes at end of table.

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Table 3.—Australia: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1974-75	1975-76	Principal sources, 1975-76
METALS —Continued			
Tin:			
Oxides	5	9	United Kingdom 5; Netherlands 2; Japan 1.
Metals including alloys:			
Scrap	([3])	--	
Unwrought	27	41	Malaysia 32; Japan 6; China, People's Republic of, 2.
Semimanufactures	42	19	United Kingdom 11; United States 4; West Germany 2.
Tungsten:			
Ore and concentrate	--	--	
Metal including alloys, all forms	12	4	West Germany 2; United States 1; United Kingdom 1.
Other:			
Ores and concentrates:			
Of niobium, tantalum, titanium, vanadium, zirconium	11	6	All from United Kingdom.
Of base metals, n.e.s	4,726	7,550	Philippines 4,000; United States 3,201; Republic of South Africa 328.
Ash and residue containing nonferrous metals	7,683	364	New Zealand 202; Japan 128; West Germany 20.
Oxides, hydroxides, peroxides of metals, n.e.s	1,854	12,239	Japan 9,538; United Kingdom 881; United States 801.
Metals including alloys, all forms:			
Metalloids	2,668	1,707	United States 821; Japan 346; Canada 326.
Alkali, alkaline earth, and rare-earth metals	87	70	United Kingdom 50; Austria 7; Japan 5.
Base metals including alloys, all forms, n.e.s	407	63	India 15; United States 14; West Germany 13.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	935	492	United States 270; New Zealand 137; Italy 38.
Grinding and polishing wheels and stones	1,319	1,071	United Kingdom 184; West Germany 169; Japan 167.
Asbestos:			
Chrysotile	30,800	30,744	Canada 29,447; West Germany 880; Republic of South Africa 377.
Amosite	11,546	12,148	Republic of South Africa 11,327; Canada 597; West Germany 224.
Other	8,658	11,604	Canada 10,918; West Germany 463; China, People's Republic of, 100.
Barite and witherite, natural and ground	1,400	610	China, People's Republic of, 605; West Germany 5.
Boron materials:			
Crude natural borates	913	14	United States 13.
Oxide and acid	3,397	2,683	United States 2,681.
Cement[4]	36,839	27,770	Japan 17,433; United Kingdom 4,475; West Germany 1,888.
Chalk	10,074	8,406	United Kingdom 4,234; France 3,032; New Zealand 1,079.
Clays and clay products (including all refractory brick):			
Crude, n.e.s.:			
Bentonite	50,215	63,732	United States 63,705.
Fire clay and ball clay	4,770	10,912	United States 10,210; United Kingdom 482.
Andalusite, mullite, dinas earth, kyanite, and sillimanite	2,010	1,268	United States 1,190; Republic of South Africa 40; United Kingdom 37.
China clays including kaolin	10,028	4,941	United States 4,116; United Kingdom 825.
Other	31,526	16,625	United States 15,656;United Kingdom 312; Japan 207.
Products:			
Refractory (including nonclay brick)[5]	34,597	29,237	Japan 12,726; United Kingdom 6,086; United States 3,792.
Nonrefractory value, thousands	$24,205	$27,940	Japan $15,348; Italy $6,983; United Kingdom $1,650.
Cryolite and chiolite	193	183	All from Denmark.
Diamond:			
Gem, not set or strung metric carats	89,501	86,228	Israel 31,040; Belgium-Luxembourg 26,663; India 10,669.
Industrial, including dust do	923,761	744,655	United States 241,236; Ireland 216,084; United Kingdom 109,364.

See footnotes at end of table.

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Table 3.—Australia: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1974-75	1975-76	Principal sources, 1975-76
NONMETALS —Continued			
Diatomite and other infusorial earth	9,895	5,821	United States 5,427; Mexico 216; Japan 142.
Feldspar, leucite, and nepheline	6,166	10,826	Norway 7,130; Canada 3,007; China, People's Republic of, 595.
Fertilizer materials:			
Crude:			
Nitrogenous	3,135	2,816	All from Chile.
Phosphatic	2,647,410	1,461,296	Nauru 642,661; Christmas Island 502,981; Gilbert and Ellice Islands 277,823.
Manufactured:			
Nitrogenous	12,288	6,510	Japan 5,167; West Germany 830; United States 147.
Phosphatic (excluding slag)	332	111	Japan 58; West Germany 32; Sweden 21.
Potassic	211,109	110,190	Canada 77,627; United States 31,044; West Germany 1,268.
Other, including mixed	4,767	4,042	West Germany 2,411; United States 726; Netherlands 406.
Ammonia value, thousands	r$1,373	$4	United States $2; United Kingdom $2.
Fluorspar	30,627	24,874	China, People's Republic of, 11,273; Republic of South Africa 9,007; Thailand 4,520.
Graphite, natural	1,269	1,289	Republic of Korea 589; China, People's Republic of, 305; Sri Lanka 191.
Gypsum and plasters	904	1,166	United Kingdom 828; United States 251; West Germany 74.
Iodine	47	46	Japan 28; United States 14; Indonesia 4.
Lime value, thousands	$37	$20	United Kingdom $10; France $6; United States $3.
Magnesite, crude, calcined, fused	174	2,604	Japan 2,500; Greece 71; United States 16.
Mica:			
Crude, including splittings and waste	888	609	Republic of South Africa 220; China, People's Republic of, 202.
Worked, including agglomerated splittings value, thousands	$410	$230	United Kingdom $70; United States $50; Switzerland $39.
Pigments, mineral:			
Natural, crude	792	1,196	United Kingdom 346; Austria 320; West Germany 295.
Iron oxides, processed	9,448	6,735	West Germany 5,495; Spain 718; United Kingdom 254.
Precious and semiprecious stones, except diamond:			
Natural value, thousands	$6,011	$10,256	Brazil $5,224; Thailand $1,267; Hong Kong $617.
Manufactured do	$468	$231	Switzerland $67; West Germany $45; Austria $34.
Salt	44,434	67,879	United Kingdom 43,884; Bahamas 23,173; Netherlands 364.
Sodium and potassium compounds, n.e.s.:			
Caustic soda value, thousands	$52,301	$5,084	NA.
Caustic potash, sodic and potassic peroxides	2,777	1,224	Japan 560; West Germany 281; India 248.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	3,835	2,677	Italy 2,477; Portugal 49; Greece 35.
Slate	741	712	Republic of South Africa 477; Italy 134; Portugal 56.
Other	1,610	2,791	Republic of South Africa 1,441; Canada 845; Finland 225.
Worked value, thousands	$1,329	$1,144	Italy $685; United Kingdom $102; Taiwan $95.
Dolomite	416	172	United States 127; France 12; New Zealand 8.
Gravel and crushed rock	411	255	Republic of South Africa 55; United States 46; New Zealand 42.
Limestone (except dimension)	1,591,609	1,426,467	Japan 1,385,939; New Zealand 448.
Quartz and quartzite	1,121	343	Sweden 190; West Germany 111; United States 42.
Sand, excluding metal-bearing	1,182	643	Sweden 288; New Zealand 149; United States 101.
Sulfur:			
Elemental:			
Other than colloidal	580,183	156,493	Canada 144,180; Iran 12,021; United Kingdom 167.

See footnotes at end of table.

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Table 3.—Australia: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1974-75	1975-76	Principal sources, 1975-76
NONMETALS —Continued			
Sulfur —Continued			
Elemental —Continued			
Colloidal	54	118	West Germany 90; United States 18; France 9.
Sulfur dioxide	369	96	Japan 89; Sweden 7.
Sulfuric acid, oleum	620	623	Japan 611; United States 11.
Talc, steatite, soapstone, and pyrophyllite	1,062	579	China, People's Republic of, 352; United States 186; Norway 23.
Vermiculite	3,639	3,496	Republic of South Africa 2,391; China, People's Republic of, 792; United States 278.
Other nonmetals, n.e.s.:			
Crude	936	1,303	France 1,129; West Germany 73; United States 32.
Slag, dross, and similar waste, not metal-bearing:			
From iron and steel manufactures	91	4	NA.
Slag and ash, n.e.s	17	64	United Kingdom 49; United States 14.
Oxides and hydroxides:			
Magnesium	21,376	9,533	Japan 9,076; United States 349.
Strontium and barium[6]	5,040	230	United States 146; Japan 58; West Germany 10.
Building materials of asphalt, asbestos and fiber cement, and unfired nonmetals, n.e.s. value, thousands	$9,887	$767	United States $255; United Kingdom $247; New Zealand $147.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	925	816	United States 576; Trinidad and Tobago 230; Argentina 10.
Carbon black	2,167	582	United States 230; West Germany 95; Canada 90.
Coal, all types, including briquets	14,230	1,389	United States 718; Japan 338; United Kingdom 332.
Coke and semicoke	17,037	1,261	United States 1,062; Norway 150; Japan 49.
Peat	5,441	30,227	West Germany 19,685; Ireland 10,276; United Kingdom 158.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	60,276	55,245	Saudi Arabia 26,263; Iran 6,542; Iraq 5,988.
Refinery products:			
Gasoline do.	2,646	4,874	Bahrain 2,106; Singapore 1,237; Republic of Korea 356.
Jet fuels do.	187	228	Singapore 198; Bahrain 26; Iran 2.
Kerosine do.	604	430	People's Democratic Republic of Yemen 203; Iran 146; Singapore 55.
Distillate fuel oil do.	3,985	3,695	Singapore 3,113; Bahrain 314; People's Democratic Republic of Yemen 208.
Residual fuel oil do.	14,906	14,165	Singapore 4,214; Bahrain 3,873; Kuwait 3,812.
Lubricants do.	565	327	Netherlands Antilles 137; United States 104; United Kingdom 43.
Other:			
Liquefied petroleum gas do.	1	1	Mainly from France and the United States.
Bitumen and other residues and bituminous mixtures, n.e.s do.	47	31	Singapore 25; United States 3; United Kingdom 1.
Petroleum coke do.	683	541	United States 427; Canada 108; Netherlands 5.
Unspecified do.	3,492	2,313	Bahrain 1,731; Iran 282; United Kingdom 101.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals value, thousands	$4,612	$3,503	Singapore $1,992; United States $1,368; United Kingdom $86.

[r]Revised. NA Not available.
[1]Data for years beginning July 1.
[2]Partial figures; excludes quantities valued at $12,020,495 in 1974-75 and $6,498,000 in 1975-76.
[3]Less than 1/2 unit.
[4]Partial figures; excludes quantity valued at $1,923,000 in 1975-76 and $1,068,000 in 1974-75.
[5]Partial figures; excludes quantities valued at $277,000 in 1975-76 and $433,000 in 1974-75.
[6]Includes an unreported amount of magnesium hydroxides and peroxides.

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COMMODITY REVIEW

METALS

Aluminum.—World demand for aluminum increased during 1977, and production in Australia's aluminum industry continued the traditional upward trend. Output of bauxite, alumina, and aluminum showed increases. Advances in primary aluminum output resulted mainly from the commissioning of additional smelting capacity in mid-1977 at Bell Bay, Tasmania, by Comalco Ltd. Also, smelters at Alcoa of Australia Ltd. at Point Henry, Victoria, and of Alcan Australia Ltd. at Kurri Kurri, New South Wales, operated at full capacity throughout 1977. The record high output of alumina was owing to expanded capacity by Alcoa at Pinjarra and Kwinana in Western Australia. Full production capacity was also reported by Queensland Alumina Ltd. (QAL) at Gladstone, Queensland, and Nabalco Pty. Ltd. at Gove, Northern Territory. Higher bauxite production was reported at the three main producing areas—Weipa in Queensland, Gove in the Northern Territory, and the Darling Range, Western Australia.

Australia's total aluminum output was attributed to the full utilization of expanded capacity by Aluminum Co. of America (Alcoa). Alcoa's total output was close to the combined capacity of the Pinjarra and Kwinana refineries of 2 million and 1.4 million tons, respectively. Output from Gladstone and Gove was 2 million tons and 1 million tons, respectively.

Total production of bauxite rose about 8% above the 1976 level. At Weipa, on Cape York Peninsula, Comalco produced approximately 15% of the Western World's total bauxite supply. Comalco, which is owned 45% by Conzinc Riotinto of Australia Ltd., 45% by Kaiser Aluminum & Chemical Corp., and 10% by the Australian public, produced about 10.2 million tons of bauxite. The company shipped about 5 million tons to international markets, principally Europe and Japan. However, the largest single outlet was the Gladstone alumina refinery operated by QAL. Comalco supplied all the bauxite requirement for QAL, and, in 1977, about 52% of all bauxite shipped from Weipa was processed by QAL. Rated capacity of QAL's Gladstone refinery was 2.2 million tons annually, making it the largest alumina refinery in the world. In 1977, its production was a record high 2.1 million tons.

Rising bauxite demand has led to a 3-year development program by Comalco, with a proposed total expenditure of $81 million. This expenditure is intended to provide the facilities to permit a 12% increase in total bauxite capacity to 11.3 million tons annually. New furnaces, commissioned at Comalco's Bell Bay smelter, increased metal production capacity from 93,000 tons to 112,000 tons per year. A new casting station was also commissioned to meet the need for increased output.

Comalco's proved, probable, and possible ore reserves at the end of 1977 comprised 3.1 billion tons, with a recoverable bauxite content of 2.5 billion tons. The grade of recoverable bauxite in the 599 million tons of proved reserves ranged from 53% to 56% alumina. The alumina content in the probable reserves was in the range of 48% to 56% alumina.

Nabalco's bauxite and alumina project operated continuously throughout 1977. The plant at Gove is one of the world's largest alumina producers, with a capacity in excess of 1 million tons per year. It can readily be expanded to produce 2 million tons annually. Gove's alumina was exported to smelters in a number of countries in Western Europe, principally Norway, and in Iceland, Egypt, and the United States.

Alcoa, a fully integrated producer of bauxite, alumina, primary aluminum, and fabricated products, operated bauxite mines at Jarrahdale, Del Park, and Huntly, all in the Darling Range. Bauxite from Jarrahdale supplied a refinery at Kwinana, near Perth, and the refinery at Pinjarra used bauxite mined at Del Park and Huntly. The alumina was reduced to aluminum at the company's smelter at Point Henry.

Alcoa was planning a new refinery near Wagerup, 120 kilometers south of Perth. Construction of the 200,000-ton-per-year refinery was scheduled to start in 1978 and it was to come onstream in 1981. The design of the plant was to allow for expansion to 4 million tons per year.

The company's production of primary aluminum increased 4% in 1977 owing to the commissioning of additional smelting capacity at Bell Bay. The Alcoa and Alcan smelters operated at full capacity throughout the year. Total capacity of the three smelters was 247,000 tons annually, slightly above the 1977 output.

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Exports of alumina totaled 6.1 million tons, valued at about $629 million, compared with 5.8 million tons, valued at $527 million in 1976. The average unit value of alumina exports continued to increase during the year, and at yearend it was $102.87 per ton (f.o.b.). Aluminum exports increased 20% over those of 1976. The value of exports totaled $70 million, about 55% above the 1976 value.

Copper.—Australian copper producers were faced with a worldwide buildup of stocks, rising production costs, declining consumer demand, and weakening prices during 1977. Despite these problems, domestic copper output declined only slightly (less than 1%). An increase in mine output by Mount Isa Mines Ltd. (MIM) in Queensland and by Mount Gunson Mines Pty. Ltd. in South Australia failed to offset lower production by Mount Lyell Mining & Railway Co. Ltd. in Tasmania. Production by Cobar Mines Pty. Ltd., located in New South Wales, also declined, and Gunpowder Copper Ltd. in Queensland ceased all mining operations in September 1977.

Full production was resumed in March by Samin Ltd. (Burra mine) in South Australia. Production of copper concentrate increased markedly in the second quarter, whereas previously the plant had operated at about 60% capacity.

Owing to the unfavorable economic conditions, production at several of the smelters and refineries was also down. At MIM, although mine production increased, both smelter and refinery output declined about 13% below the plant's annual capacity of 160,000 tons. At Port Kembla, New South Wales, where Electrolytic Refining and Smelting Co. of Australia Ltd. processed concentrates from Cobar and Mount Lyell, output declined. The smelter at Tennant Creek, in the North Territory, remained closed, and the mining emphasis there was on gold and the byproduct copper treated at Mount Morgan, Queensland.

The quantity of ore treated by MIM increased 12.7% (4.9 million tons) over that of 1976. About 97% of the total ore mined came from the 1100 ore body. Mining from the pillars of the 650 ore body was completed. Pillar extraction in the 650 ore body started in 1966, and this program resulted in the recovery of 2.5 million tons of ore. The recovery of pillars in the 1100 ore body reached a high degree of activity during the year and, in contrast to the program for the 650 ore body, it could continue as an integral activity of the mining program. With the 650 ore body, the pillar recovery phase occurred after the extraction of the major part of the ore body had been completed.

At MIM's Townsville copper smelter, a new $12.5 million electrostatic precipitator was commissioned with associated gas-handling equipment. Other new equipment included fume hoods on two converters, extensive instrumentation control devices, and the installation of equipment for environmental control. Output at the Townsville copper refinery declined 4.6% from that of the previous year. Power restrictions owing to industrial trouble at the Northern Electric Authority's generating station at Collinsville affected refinery production early in the year. In one 3-month period, the plant was restricted to a production rate of 90% of design capacity.

The new $4.24 million continuous rod rolling installation at Copper Refineries Pty. Ltd. (MIM subsidiary), was commissioned in September. The principal components in the line were a continuous-casting unit, which featured horizontal pouring of refined copper, and a unique new process for the rolling of cast copper bars into rods. This new development in continuous casting and rolling could result in better control of casting and greater reliability during the difficult startup operations.

Work at the MIM's Hilton mine was confined to a continuation of the underground diamond-drilling program for the confirming of ore reserves. The geological characteristics of the Hilton ore bodies are significantly different from those at Mount Isa, and more extensive information is required about them for planning purposes. The program that had been undertaken from locations on the No. 4 level was completed; and at yearend, diamond-drilling activities were being conducted from the No. 10 level.

Mount Lyell Mining & Railway Co. milled 1.8 million tons of ore and produced 70,237 tons of copper concentrates at its Queenstown, Tasmania, plant. Ore output declined 18% owing to a reduction from the two principal sources, Prince Lyell and Cape Horn. The company recorded substantial losses and received some financial assistance from Government sources to enable continued operations. The mine was the only industry in an isolated area, and any further curtailment of operations would have a serious effect on the dependent community.

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Peko-Wallsend Ltd.'s copper mining operations at Tennant Creek, Northern Territory, remained closed throughout 1977. Since the closure in February 1975, due to soft copper prices and technical difficulties, studies have continued on methods to make the smelters more efficient. Some 12,600 tons of copper concentrate was produced as a byproduct of mining gold-bismuth ore at Peko-Wallsend's Warrego mine. The Warrego concentrator was expanded by the addition of a gold ore treatment plant and facilities to differentially float gold-bismuth ore. This enabled a transfer of all milling and concentrate production to Warrego with consequent greater efficiency and lower cost per ton.

Cobar Mines Pty. Ltd. treated 609,600 tons of run-of-mine copper ore to yield 30,528 tons of copper concentrate assaying 26.4% copper. The average grade of copper ore treated was 1.15% copper. Production schedules were restructured in 1977 to alleviate the adverse effects of high production costs and low prices. A target annual production rate of 600,000 tons of ore was set, and the company expected to maintain this rate for several years. Development would be restricted to that required for the open stoping areas accessible from former development. The workforce was reduced to 200 employees, but increased extraction from the more highly productive open stopes enabled ore production to exceed planned output of 600,000 tons. Copper concentrate continued to be sold under long-term contract to the Electrolytic Refining and Smelting Co.

Despite the somewhat depressed outlook for copper, base metal companies were actively exploring for new resources. Western Mining Corp. Ltd. (WMC) continued diamond drilling at the Olympic Dam prospect near Roxby Downs station in South Australia where 13 vertical holes were completed during 1977. Nine of these intersected an extensive zone of copper and uranium mineralization varying between 8 and 248 meters in thickness, with grades generally between 1.0% and 2.4% copper. The mineralized zone was encountered at about 350 meters below the surface. The holes were widely spaced over an area of 1,500 by 400 meters, but the rock type and the nature of the mineralization were similar enough to suggest continuity. Also, a joint exploration venture by WMC-BP Australia Pty. Ltd. intersected massive sulfides containing copper as well as silver-lead-zinc. The discovery was made near Benambra, Victoria, about 25 kilometers northeast of the small township of Omeo. Further drilling will be needed to determine the extent of mineralization.

Table 4.—Australia: Major copper production, by company

(Metric tons, metal content of ore)

Facility	1975	1976	1977
Mine:			
Mount Isa Mines Ltd	150,112	146,979	155,945
Mount Morgan Ltd	8,241	6,420	5,586
Cobar Mines Pty. Ltd	9,713	5,840	5,640
Mount Lyell Mining & Railway Co. Ltd	23,240	r24,037	20,394
Electrolytic Zinc Co. of Australasia Ltd. (EZ Co.)	1,278	1,723	1,625
Peko-Wallsend Ltd	14,525	9,543	4,443
Smelters:[1]			
Mount Isa Mines Ltd	160,525	149,620	139,110
Mount Morgan Ltd	r8,841	r10,268	5,420
Electrolytic Refining and Smelting Co. of Australia Pty. Ltd.[2]	r18,819	r17,923	14,898
Refineries:[3]			
Mount Isa Mines Ltd	148,370	r145,785	139,143
Electrolytic Refining and Smelting Co. of Australia Pty. Ltd	26,280	r14,871	13,681

rRevised.
[1]Primary blister copper.
[2]Treats concentrates from Cobar.
[3]Primary electrolytic copper.

Gold.—Despite closure of several mines, gold production increased 24% over that of 1976. The increase was partly owing to higher output from established producers in Western Australia, but the start of production from the Telfer Mine, also in Western Australia, had significant contribution. The Treasurer's announcement in the budget speech that the income tax exemption on production of gold would be continued was of considerable assistance to Australia's gold producers. Also, the devaluation of the Australian dollar at the end of 1976 effectively increased the Australian produc-

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ers' price of gold, which helped the surviving mines.

The Telfer open pit gold project, in which Newmont Pty. Ltd. had a 70% interest and The Broken Hill Pty. Co. Ltd. (BHP), 30%, was commissioned in March. About 4.2 million tons of ore, averaging 0.28 troy ounce of gold per ton, was scheduled to be mined by open pit methods during the first 10 years. The ore was completely oxidized, and the gold occurred as discrete particles of varying sizes but mostly as fine grain. The ore was partially free milling, and up to 40% of the gold was recoverable by a gravity process. The remainder was recovered by conventional cyanide leaching. Because of the remote location of Telfer, living facilities have been constructed at the site, which is about 450 kilometers from Port Hedland.

Central Norseman Gold Corp. N.L. was the largest producer of gold in Western Australia. The company produced approximately 100,000 troy ounces in 1977. It was developing the 4 and 5 levels of the North Royal Mine, which was the main source of the gold produced. In addition, the company was designing a new open pit to mine high-grade ore near the surface. Ore reserves were estimated at 350,000 tons averaging 0.53 troy ounce of gold per ton.

The Warrego mine (formerly a copper mine), operated by Peko-Wallsend, was the only producing gold mine at Tennant Creek. The Warrego copper concentrator was modified to treat Warrego gold ore. The company was continuing to develop the Gecko copper mine, which had a comparatively low gold content.

The Blue Spec gold mine at Nullagine, Western Australia, was in production throughout 1977. The mine, operated by Australian Anglo American Ltd., experienced difficulty in reaching the expected head grade of ore; recovery of gold was below the expected figure. However, the company was actively engaged in exploration and metallurgical research work designed to overcome the problems.

Kalgoorlie Lake View Pty. Ltd. continued to operate the Mount Charlotte mine at Kalgoorlie, but the Fimiston mine remained closed. During the previous year, the company formed a partnership with Homestake Gold Ltd. to form Kalgoorlie Mining Associates. In early 1977, the partnership announced plans to place the Mount Charlotte mine on a care-and-maintenance basis because the operation was uneconomical. By midyear, however, the price of gold increased sufficiently to enable the mine to continue working. Kalgoorlie Mining Associates announced in late 1977 that it would spend up to $24 million in modernizing the treatment plant at Fimiston. As a result of the improved ore treatment facilities, which were to include the installation of a crushing section at the mine, the company expected to reduce its overall cost of production by $10 per ounce.

The principal gold producers and quantities recovered during 1977 were as follows:

Company	Production (troy ounces)
Central Norseman Gold Corp. N.L.	102,000
Kalgoorlie-Lake View Pty. Ltd	101,500
Mount Lyell Mining & Railway Co. Ltd	11,146
Peko-Wallsend Ltd	172,241

Iron and Steel.—Despite the pressure of the continued worldwide recession on demand for steel and an unprecedented number of prolonged strikes by several major Australian ore producers, the iron ore industry advanced in 1977. However, continued recession in the steel industry could create problems for Australian producers. Japanese steel mills began reducing imports within the limits of their contractural obligations. Although Australian producers did not reduce output, a buildup in stocks could force them to do so. As in recent years, most of the iron ore was produced in the Pilbara region in northwest Western Australia. In this area, five companies produced about 90% of Australia's total iron ore output: Hamersley Iron Pty. Ltd. (Mount Tom Price and Paraburdoo), Mount Newman Iron Ore Pty. Ltd. (Mount Whaleback Hill), Cliffs Western Australian Mining Co. Pty. Ltd. (Robe River), Goldsworthy Mining Ltd. (Mount Goldsworthy, Shay Gap, Sunrise Hill), and Dampier Mining Co. Ltd. (Koolan Island and Yampi Sound). Outside the Pilbara region, iron ore at Kollyanobbing was mined by Dampier for use in the Kwinana blast furnace. In South Australia, The Broken Hill Pty. Ltd. Co. (BHP) produced ore from the Middleback Ranges for steelplants in South Australia (Whyalla) and in New South Wales (Newcastle and Port Kembla). About 2 million tons of iron ore at the Savage River operation in Tasmania was slurried and pumped to a pelletizing plant at Port Latta for shipment to Japan.

The remoteness and the harsh environ-

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ment of the Pilbara area created special problems for producers. In April, a severe cyclone caused costly damage to the rail link between Mount Goldsworthy and Port Hedland, and shipments to Japan were suspended for 3 weeks. Industrial strikes were fairly common in the Pilbara area and were of concern to Government, companies, and the trade unions. A major strike disrupted Mount Newman operations in June and July, and a number of smaller stoppages occurred from time to time at other mines. The Savage River operation in Tasmania was closed by a strike throughout July.

The Australian iron ore industry was almost entirely export oriented, with about 75% of exports bought by Japanese steel mills under longterm contracts. Most Japanese longterm ore contracts carry a "plus or minus" option provision under which deliveries in any one year can vary up to 10% of the contract tonnage. Although shipments declined 2 million tons, earnings were enhanced by the devaluation of the dollar and price increases applying to some contracts. This increase in earnings was partly offset by the rising costs of production. However, for most companies 1977 was more profitable than 1976.

Ore prices varied between contracting companies, as prices were negotiated by the individual exporter. Several prices applicable to the longterm contracts of Australian producers were renegotiated in 1977. Hamersley and Mount Newman, the two principal ore exporters, reached agreements with Japanese companies on ore prices. Hamersley's number one contract was for 5 million tons of ore annually. Lump ore remained at $17.74 per ton f.o.b. until April and increased to $18.43 per ton in October. Fines remained at $14.13 until September and increased to $14.76 per ton in October. The Mount Newman contract covered 7.5 million tons annually. Lump ore began the year at $16.64 per ton and increased to $18.81 per ton in October. Fines ranged from $12.88 per ton to $14.00 per ton during the corresponding period.

Production at the two mines operated by Hamersley (Mount Tom Price and Paraburdoo) declined 8% compared with the 1976 level. The decline was attributed to industrial disputes, which stopped ore production, and a drop in demand by Japanese steel producers. The company produced about 33 million tons of iron ore during the year, slightly less than the 1976 total. The principal shipping products included 16 million tons of fines, 14 million tons of lump ore, 2 million tons of pellets, and 1 million tons of low-grade ore. The largest receiver was Japan (24 million tons composed of all four products), followed by Europe (6 tons of fines and lump ore), and the United States (200,000 tons of low-grade ore). Hamersley announced plans that would increase its capacity from 40 to 46 million tons of salable ore per year. The expansion, costing about $375 million, was expected to be completed early in 1979. It involved the installation of a concentration plant to treat low-grade ore and to improve the grades and physical properties of total production. This would also enable concentrate output of suitable quality for feeding to direct-reduction steelmaking processes. In addition to heavy-media separation and wet high-intensity magnetic separation beneficiation plants, the concentrator complex included various integrated facilities.

Production by Mount Newman consortium, a joint venture operated by Mount Newman Mining, was 6% above that of 1976. The increase resulted from the company's decision to stockpile iron ore and from fewer strikes than in 1976. Mount Newman continued work on a heavy-media separation project, with estimated capital of $113 million. The facility would have an annual capacity to treat 7 million tons of lower grade iron ore to produce 5 million tons of high-grade lump and fine ore. Beneficiation would be accomplished by the gravity method.

Goldsworthy Mining's production of 6 million tons was slightly below that of 1976. Goldsworthy announced it would cease production in the Pilbara by mid-1981. With no contract in sight for its 700 million tons of Area C iron ore, Pilbara's Goldsworthy project will stop when its existing ore reserves and contracts run out. The company had only 16.3 million tons of iron ore reserves and contracts to supply 5.5 million tons annually for the next 3 years.

The principal Australian iron ore producers and their output in 1977 were as follows, in thousand tons:

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Company, location, and product	Quantity
Hamersley Iron Pty. Ltd., Western Australia (lump and pellets)	33.1
Mount Newman Iron Ore Co. Mining Pty. Ltd., Western Australia (lump)	29
Goldsworthy Mining Ltd., Western Australia (lump)	6
The Broken Hill Pty. Co. Ltd. (BHP), South Australia (lump and pellets)	6
The Broken Hill Pty. Co. Ltd. (BHP) Western Australia (lump)	2

Australian reserves of iron ore were established at 35 billion tons, comprising 25.8 billion tons of hematite with 54% or more iron content, and 9.2 billion tons of limonite with 50% or more iron content. Most of Australia's reserves occur in the Pilbara region of Western Australia, which accounted for over 90% of production in 1977. New mines in the area, however, are unlikely unless iron ore prices rise substantially because none of the three planned projects is economically viable at present prices. Japanese steel mills announced that they would not take part in any new Western Australia iron ore projects until the early 1980's.

BHP remained the only steel producer in Australia, with plants at Newcastle and Port Kembla in New South Wales, Whyalla in South Australia, and Kwinana in Western Australia. Compared with 1976, total production of raw steel fell 3.5%, the lowest since 1973. Total capacity was about 9 million tons per year. Despite idle capacity, the company planned to expand capacity to follow estimated future market requirements. At many BHP facilities, expansion plans were completed or in various stages of progress. At Newcastle, major completed projects included No. 1 rod mill modifications. Work on effluent control was completed at the blast furnace and was continuing at the coke ovens. Major works completed at Port Kembla included conversion and relining of the No. 3 blast furnace. Some effluent control work was also completed at the coke ovens. Work was continuing on several other major projects including the continous slab casting and vacuum degassing plant and the uprating of No. 5 blast furnace. At Whyalla, repair work on the No. 2 blast furnace was completed. The major development still in progress was the extension on the coke ovens battery. The Geelong rod mill was commissioned in March and operated satisfactorily throughout the year. Work continued on the new coil-plate-processing line at Westernport, Victoria.

Lead and Zinc.—The improvement in the lead market was reflected by an increase in production of both commodities. Nearly all of Australia's lead and zinc was produced from deposits in which these two metals occur together in various proportions in the ore. The need to meet firm demand for lead resulted in a high level of zinc production and a buildup of stocks. Mine production of lead increased 9% above that of 1976. This increase was largely the result of increased output from Mount Isa and from two of the three mines operating at Broken Hill, but increases were also recorded at all other major mines.

Mine production of zinc increased 5% above that of 1976. The decline in output at Mineral Mining & Metallurgy Ltd.'s (MMM) Broken Hill mine and a small decrease in concentrate output at Mount Isa failed to offset substantial increases in production by Australian Mining & Smelting Co. Ltd. (AM&S) at Broken Hill and Electrolytic Zinc Co. at Read-Rosebery.

MIM remained Australia's largest single producer of lead and zinc. Again, as in 1976, 2.4 million tons of lead-zinc ore was mined, but the average grade was higher than in the previous year. Mining moved progressively deeper over the years and was concentrated between the 13 level (670 meters) and 15 level (730 meters). Although lead ore grade was higher and treatment rates comparable, the output of lead metal was restricted by environmental control actions. Lead smelter operations had to be curtailed or shutdown fairly frequently in order to maintain acceptable air quality standards at Mount Isa. To achieve the desired production levels and the appropriate environmental standards, the company decided to construct a new stack for the lead smelter together with an associated spray tower and flue system. The new stack will be 270 meters high, one of the highest structures in Australia. The estimated cost of the stack and its associated equipment is $6.7 million.

An agreement was made between the Australian Government and MIM for further exploration and study of the McArthur River zinc-lead deposit in the Northern Territory. Operation of a 50-ton-per-day pilot plant began in June to test the feasibility of commercial development. A major drilling program was also underway. MIM had conducted work at McArthur River for several years, but development was hin-

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dered by metallurgical problems involved in concentrating the fine-grained ore. Sixty people were employed at the site.

Mine production by AM&S' two subsidiaries—Zinc Corp. Ltd. and New Broken Hill Consolidated Ltd. (NBHC)—was at a higher rate than that of 1976. This increase was attributed to increased ore that became available from long-hole stopes and the availability of additional experienced miners. These two factors were offset somewhat by the lower grade of ore produced. Emphasis continued to be placed on development for long-hole stoping in both Broken Hill mines, where practicable. Investigation of sand fill consolidation and of pillar mining methods aimed at improving productivity of future extraction of pillars of ore was well underway. The Zinc Corp. concentrator continued production of two grades of zinc concentrate. Many of the problems encountered earlier in retreating old mine residues were resolved, and the planned rate of concentrate production was achieved.

Because of the depressed zinc market, the Sulphide Corp. Pty. Ltd. smelter at Cockle Creek, New South Wales, continued to operate well below capacity. A more diverse range of raw materials was processed through the smelter. Development of briquet technology for recycled process materials continued successfully, with the pilot plant operating on a semicommercial basis.

The Broken Hill Associated Smelters Pty. Ltd. (BHAS) at Port Pirie, South Australia, increased both lead and zinc output over that of 1976. However, BHAS operated below capacity, largely because of strike action in April and May. Research on reflux refining of lead in collaboration with the Commonwealth Scientific Industrial Research Organization (CSIRO) was continuing. The company is committed to a pilot development process for several years.

EZ Industries Ltd.'s output from its Rosebery, Farrel, and Hercules mines varied several times during the year as a result of fluctuating market demand. Production declined to 70% of capacity early in the year and progressively increased to about 90% of capacity by June, but was substantially reduced at yearend. However, the combined output of total ore mined was 606,278 tons, 17% more than that in 1976. The increased production from the Rosebery mine was achieved mainly in the second half of the year from the introduction of an additional sublevel long-hole stope, an increase in the number of conventional stope mining parties, and an increase in development of ore. The rate of mine development increased significantly (4,013 meters at the Rosebery mine and 23 meters at the Hercules Mine, compared with a total of 2,725 meters in the previous year). The two fluid roasters treated a total of 351,779 tons of concentrate during the year.

The average grade of mine production was 12.5% zinc, 3.7% lead, and 5 troy ounces of silver per ton. Products of the concentrating mill were zinc, lead, copper, silver, gold, and pyrite concentrates, which were railed to the port of Burnie. There were 11 line-haul locomotives and 69 bulk wagons of 44-ton capacity on the railway. Traffic on the line exceeded 500,000 tons per year.

A consortium, consisting of Conzinc Riotinto of Australia and St. Joe Minerals Corp. and Phelps Dodge Corp. of the United States, began production from its $80 million open pit mine located about 65 kilometers northeast of Canberra. The operation was expected to annually produce about 1 million tons of ore, 70,000 tons of zinc, 20,000 tons of lead, 12,000 tons of copper, and 1.8 million troy ounces of silver. Output would be divided among the three joint venture partners, each of which would arrange its own sales. Diamond drilling revealed ore reserves of 10 million tons, averaging 12% zinc, 4.5% lead, 1.8% copper, and 1.8 troy ounces of silver per ton.

Table 5.—Australia: Lead-zinc production, by major company

(Metric tons)

Mine	1975		1976		1977	
	Lead	Zinc	Lead[r]	Zinc	Lead	Zinc
North Broken Hill Ltd	57,192	39,308	60,000	[r]50,000	52,877	39,442
The Zinc Corp. Ltd	78,950	88,700	83,210	55,800	86,240	56,700
New Broken Hill Consolidated Ltd	83,120	116,300	76,790	136,200	78,240	137,200
Mount Isa Mines Ltd	131,689	115,209	140,000	[r]110,000	131,390	101,027
Electrolytic Zinc Co. of Australasia Ltd. (Read-Rosebery)	18,162	60,801	15,000	[r]65,000	20,459	70,341

[r]Revised.

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Manganese Ore.—Production declined substantially owing to reduced world steel output and large consumer stocks. More than 90% of the output was supplied by the Groote Eylandt Mining Co. Pty. Ltd. (GEMCO), a subsidiary of BHP, where production declined 24%.

GEMCO shipped 1.2 million tons of manganese ore from its operations in the Northern Territory. Again, the largest tonnage (610,000) went to Japan. About 270,000 tons was shipped to Europe, 150,000 tons to the United States, and 40,000 tons to the Republic of Korea. The remainder was domestically consumed and processed by the Bell Bay plant, operated by Tasmanian Electro Metallurgical Co. Pty. Ltd. (TEMCO), a subsidiary of BHP. Ferroalloy production at Bell Bay was 103,000 tons. Although this was 8% higher than last year, it was below plant capacity owing to limited demand. Following an intensive marketing program, 37,000 tons of ferroalloys was exported, compared with 5,000 tons in 1976. The effect of the world market situation for ferroalloys was reflected in the results at TEMCO, which showed a loss of $3.6 million for the year. The construction of a new 24,000-kilovolt-ampere manganese alloy furnace was nearing completion. When the expansion is completed, the plant would require about 250,000 tons of manganese ore annually, doubling the present output.

Most ore for export was sold on a contract basis, and prices were negotiated annually between buyer and seller. Japanese sources reported that prices of high-grade lump ore from Groote Eylandt increased to $65.28 per ton f.o.b. during 1977. Prices of low-grade ore reportedly remained at the $1.28 per ton unit of contained manganese f.o.b. quoted for 1976 shipments.

Australian reserves were estimated at about 890 million tons, the main part of which was on Groote Eylandt. The remainder was located principally in the east Pilbara and Peak Hill regions of Western Australia and at Pernatty Lagoon in South Australia. Known deposits in Queensland and other deposits in the Northern Territory were subeconomic. Large secondary enrichment deposits along the outcrop of the Marra Mamba iron formation in the Pilbara continued to be evaluated. These deposits were low in silica and consisted of about equal proportions of high-grade ore (40% manganese) and lower grade ores suitable for beneficiation.

Nickel.—Australia was the world's fourth largest nickel producer. Domestic production was 2% above the 1976 level. Output from major Western Australian mines increased significantly, offsetting declines at Redross and Scotia. About half of the total output came from the Kambalda Mine, operated by WMC. An additional 20% was supplied by Windara, Nepean, Redross, and Spargoville, also of Western Australia. The balance was produced at the Greenvale lateritic nickel mine in Queensland.

In 1977, WMC treated 1.5 million tons of ore and produced 292,800 tons of concentrate containing 33,340 tons of nickel. This ore included 40,159 tons purchased from the Nepean mine of Metals Exploration Ltd. At the end of 1977, WMC had eight production shafts and declines in operation. Deepening of five declines and several shaft sinkings continued during the year. The Jan shaft reached 589 meters and required an additional 38 meters for completion. It was in full production on four levels. The Edwin shaft reached 315 meters. Preparation of surface installations for the new Victor shaft was completed, and, at yearend, it had been sunk 12 meters.

In addition to operating the Kambalda and Scotia mines and managing the Windara Mine, in which it has 50% interest, WMC owns the smelter at Kalgoorlie and the refinery at Kwinana. The company treated ore and concentrates from other mines on a toll basis and also smelted the half of the Windara production owned by the Shell Co. of Australia Ltd. Annual capacity of the Kalgoorlie smelter was being expanded from 350,000 to 450,000 tons of concentrates by installing a new flash furnace and ancillary equipment. Further expansion capacity to 800,000 tons per year by the addition of oxygen to the furnace air supply was planned. The expansion was partly financed by the Agnew joint ventures for use when the Agnew project is commissioned.

Selcast Exploration Ltd. (Spargoville mine) delivered about 160,000 tons of ore to the North Kalgurli Mine Ltd. concentrator, and about 20,000 tons of concentrate containing 3,100 tons of nickel was produced. This represented an increase of about 50% above the 1976 level. The entire concentrate output was sold under contract to WMC. At Anaconda Co.-Conzinc Riotinto of Australia Ltd. (Redross mine), production declined significantly from the 27,200 tons of concentrate containing 4,100 tons of nickel pro-

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duced in 1976. The Carr Boyd mine was reopened in the first quarter of 1977, but operations at both Scotia and Carr Boyd were suspended in September as a result of low nickel prices and excess supplies available on world markets.

The Greenvale mine in Queensland, owned equally by Metals Exploration and Freeport of Australia, Inc., was operated at about 80% of designed capacity during the year. The operation, which treats lateritic ore, was the first of its kind in the Southern Hemisphere and the second largest in the world. The project was more costly to establish than the sulfide counterpart, mainly because a treatment process had to be developed. Although technical problems have been largely overcome, financial difficulties have intensified, and mounting losses have thrown doubts on the future of the operation.

The joint venture for the Agnew nickel project, comprising Western Selcast Pty. Ltd. and MIM Holding Ltd., announced that arrangements were completed to enable the project to proceed to production. The facilities would initially have an annual capacity of 10,000 tons of nickel in concentrate and were expected to begin production late in 1978. The sinking of an exploration shaft would continue simultaneously with the mine construction and development work. The concentrate from Agnew would be toll smelted to matte at the Kalgoorlie smelter of WMC. In addition to the $28 million already spent, about $86 million would be required to bring the project to production.

Nickel exploration continued by several groups, mainly in Western Australia, and some small but relatively high-grade prospects were reported. At Forrestania, Western Australia, Endeavour Oil Co. N.L. announced that diamond drilling had indicated significant additions to known ore reserves at its Digger Rocks prospect. Also, Anglo American, Australian Aquitaine Petroleum Pty. Ltd., BHP, and Kennecott Copper Corp. were actively exploring the Kimberley Range of Western Australia.

Silver.—Australia is the world's sixth largest mine producer of silver. Most of the silver was a byproduct of lead-zinc mining, but some was produced as a byproduct of copper and gold mining. In 1977, mine production rose 9%, mainly because of the higher grade of ore milled at Mount Isa and by increased output by AM&S and EZ Industries. About 89% of Australia's total output came from Mount Isa in Queensland and Broken Hill in New South Wales. Most of the remainder came from Mount Lyell, Tasmania, and Tennant Creek, Northern Territory.

MIM remained Australia's largest producer of silver. Approximately 2.4 million tons of lead-zinc ore, averaging 6.8 troy ounces of silver per ton, was treated to produce approximately 10.5 million troy ounces of silver. About 85% of the silver was recovered from lead concentrate, slightly more than in 1976. In addition, silver was recovered from both zinc and copper concentrates. At Mount Isa, the lead concentrate was smelted to lead bullion, which was exported to the company's lead refinery at Northfleet, United Kingdom, where the contained silver was recovered. About 75% of the zinc concentrate was exported; the remaining 25% was shipped to the zinc refinery at Risdon, Tasmania. Silver in copper and lead residues from the electrolytic tankhouse slimes from the Townsville copper refinery were either recovered by Electrolytic Refining and Smelting Co. of Australia Ltd. at Port Kembla or were exported.

At Mount Morgan, Queensland, silver was a byproduct of open pit copper-gold mining and was recovered in blister copper. Production in 1977, including some ore from Tennant Creek, was 36,470 troy ounces of silver.

The Broken Hill area was the second greatest source of silver. Production had declined steadily in recent years because more ore was mined from the zinc-rich lodes, which contain less than 3 troy ounces of silver per ton compared with about 7 troy ounces per ton in the lead-rich ore bodies. Most of the silver produced at Broken Hill was contained in lead concentrates, which were treated at the BHAS's smelting and refining plant at Port Pirie, South Australia.

EZ Co. produced silver as a byproduct of copper-lead-zinc mining at Rosebery. In 1977, the company treated 529,158 tons of Rosebery ore, 64,312 tons of Hercules ore, and 12,800 tons of dump material. The average silver grade of the complex copper-lead-silver-gold ore treated was 4 troy ounces, 11% lower than the average grade in 1976. The ore yielded 126,948 tons of zinc concentrate containing 471,231 troy ounces of silver, 13,870 tons of lead concentrate containing 382,146 troy ounces of silver, and 25,848 tons of copper concentrate containing 1,593,064 troy ounces of silver. Lead and

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copper concentrates were exported, and the silver in the zinc concentrate, which was treated at the Risdon refinery, was recovered in copper-lead-zinc residues.

About 80% of all silver exported was contained in lead bullion, lead, zinc, copper concentrates, blister copper, and various slags, mattes, and residues. The remainder was exported as refined silver and mint bullion.

Principal producers of silver and output during 1976 and 1977 were as follows, in thousand troy ounces:

Company	1976	1977
Electrolytic Zinc Co. of Australasia Ltd	2,780	2,446
Mount Isa Mines Ltd	9,450	10,484
New Broken Hill Consolidated Ltd	1,739	1,820
North Broken Hill Ltd	2,738	2,700
The Zinc Corp. Ltd	1,621	1,740

Tin.—With a year of production without export quotas, Australian mine production of tin-in-concentrate decreased 6% from that for 1976. Quotas imposed by the International Tin Council (ITC) were lifted in mid-1976, and after the ITC buffer stocks were exhausted in early 1977, the price of tin was effectively decontrolled. The tin mining companies then had extremely favorable market conditions with overall demand in excess of supply and a price increase of about 100%.

Renison Ltd., located in Renison, Tasmania, remained Australia's principal tin producer and was the world's largest tin producer from a hard-rock underground mining operation. Production of tin metal in concentrates increased from 4,010 tons to 6,300 tons. The mill treated 554,736 tons of ore with an average head grade of 1.36% tin, compared with 494,340 tons averaging 1.24% tin in 1976. The favorable 1977 output convinced company officials of the viability of its proposed tin smelter in Tasmania. With higher tin prices and greater profits, the likelihood of building the plant increased considerably. Currently, Australia has one tin smelter, which was operated by Associated Tin Smelters Pty. Ltd. (ATS). The Renison mine provided 50% of the plant's raw material. It was expected that only a slight increase in output would be necessary to supply its own smelter and ATS. Renison's proved and probable ore reserves totaled 9,895,000 tons averaging 1.24% tin; possible ore totaled 8,200,000 tons averaging 1.19% tin. The decrease in average grade of reserves resulted from the low average grade (1.05% tin) of ore newly added to reserves.

The increase in output by Renison Ltd. more than offset the decrease by the Abminco N.L. group (Cleveland Tin N.L., Aberfoyle Tin N.L., and Ardlethan Tin N.L.). At the troubled Cleveland Mine, at Luina, Tasmania, production of tin concentrate declined to 1,386 tons from 1,519 tons in 1976. The Ardlethan Mine, in New South Wales, produced 1,110 tons of concentrate, down from 1,180 tons in 1976, and output at the Rosarden and Storey's Creek mines dropped from 130 tons to 120 tons.

Minops Pty. Ltd. closed its small tin mine at Zeehan, Tasmania, because of declining ore values and recovery problems. The mine, which had a production rate of 45,000 tons per year, was operating on an ore value of 0.5% tin. A value of 0.8% was needed to make the operation profitable. In addition to the mine, the facility has a 60,000-ton-per-year treatment plant.

ATS, operating at Alexandria, New South Wales, was the only domestic producer of primary refined tin. The smelter is a joint venture of O.T. Lempriere and Co. Ltd. and Australian Iron and Steel Pty. Ltd. Production capacity of the smelter was rated at 15,000 tons annually of concentrates. However, the low average grade of concentrates available to the smelter reduced its effective output of refined tin to about 7,000 tons per year. Production of primary refined tin was 5,561 tons, 1% less than in 1976.

Titanium and Zirconium.—The world market for mineral sands concentrates was generally depressed throughout 1977, and some Australian producers ceased production. However, the demand for titanium dioxide pigment improved slightly, and Australian ilmenite producers were able to lift exports to a record 1.1 million tons despite intense competition. This, combined with a high level of domestic shipment, enabled producers to substantially liquidate large stocks that accumulated in recent years. Also, improved demand for rare-earth oxides in the United States and Europe enabled monazite exports to be increased to a record 7,530 tons, the bulk of which was shipped to France. Although output of both zircon and rutile declined, sluggishness in world industrial activity, particularly in the steel industry, was such that exports failed to match the level of production, and producer stocks of both zircon and rutile rose sharply.

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There was a rash of reshuffling, production cuts, and even closures in the beach sand industry of Western Australia. Allied Eneabba Pty. Ltd. was restructured so that $11 million worth of cash and credit could be injected into the company. This was achieved through the E. I. du Pont de Nemours & Co. of the United States gaining newly issued shares in Allied Eneabba and thus increased its ownership from 25% to 40%. Reshuffling was also completed by Westralian Sands Pty. Ltd. when a majority of the shareholders agreed to a merger with Western Mineral Sands Pty. Ltd. and Ilmenite Pty. Ltd., two companies owned by the British-owned Tioxide Australia Pty. Ltd. The merger gave Tioxide a 40% share in Westralian Sands with an option to increase this to 51%.

Despite marketing and price problems, the Jennings operations at Eneabba increased production. Output of the dry plant at Geraldton finished the year with an overall 12% increase in production, from 194,924 tons to 217,690 tons. Of this total, ilmenite production went up 15% to 155,691 tons; rutile increased 8% from 36,256 tons to 39,434 tons, and zircon decreased 7% from 23,875 tons to 22,235 tons.

Dillingham-Murphyores Inc. Pty. Ltd. decided to cease all mineral sands mining in Australia. The main factor in this decision was the Federal Government's decision to ban all beach sand mining on Fraser Island, Queensland. The company claimed compensation of $23 million (as compared with the Government's offer of $4 million), stating that the Fraser Island decision reduced its reserves from a life of 20 to 5 years. A second factor in the Dillingham decision was the announcement in early 1977 by the New South Wales Government that future mining in areas designated as national parks would be banned. Dillingham officials think this would prevent it from mining most of the areas where it has leases and would severely reduce the remaining mine life of its existing operations. During 1977, Dillingham operated dry-separating plants at Cudgen and Woodburn in northern New South Wales. The Cudgen plant produced 9,800 tons of rutile and 11,900 tons of zircon from wet plants at Cudgen, Fingal, and Pottsville. The Woodburn plant produced 10,100 tons of rutile and 9,700 tons of zircon from a 650-ton-per-hour trailer-mounted mobile plant and dry-mining unit, which was relocated from Tabbimobil to Broomes Head, New South Wales.

Because of reduced prices and rising costs, mining of new ore by WMC Mineral Sands Operation, a wholly owned subsidiary of WMC, was suspended in January. Production continued from accumulated stockpiles, but in May all operations were suspended and the project put on care-and-maintenance.

The proven and probable reserves of heavy minerals totaled about 70 million tons in Western Australia, 20 million tons in Queensland, and 20 million tons in New South Wales. The grade of heavy minerals ranged from 1% near Newcastle, New South Wales, to 80% at Eneabba. All producers continued exploration, most of which was in Western Australia.

NONMETALS

Phosphate Rock.—Production increased 80% over that of 1977. Queensland Phosphate Ltd. (a wholly owned subsidiary of BH South Ltd.) developed the phosphate rock deposits at Duchess, Queensland, to operate at a capacity of 1 million tons per year. Commissioning of the treatment and train-loading facilities at the mine was completed by mid-1977, and facilities at the township were completed and occupied. Handling and ship-loading facilities in Townsville were established, and a dryer became operational in May.

Total production, averaging 31.85% P_2O_5, was located mostly in the northern sector where material was direct-shipping-grade rock. Toward the end of the year, a pit was opened in the southern sector, where resources were estimated to contain 1.5 million tons, averaging 32% P_2O_5. Exports were faced with the problem of world oversupply. Domestic fertilizer manufacturers reported that the domestic phosphate rock differed chemically and physically from the material for which their plants were designed. Sales within Australia, therefore, were restricted to small quantities for plant trials, and the manufacturers advised that necessary testing, plant modifications, and evaluation would delay the use of this material on a large scale until late 1978. This affected the company's program and contributed to serious financial problems.

A minor quantity of phosphate rock, an estimated 10,000 tons in 1977, was produced in South Australia. The material was not suitable for superphosphate manufacture because of its high iron and aluminum content, and was used locally as a fertilizer.

Australian production of phosphate fertilizer, in terms of single superphosphate

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equivalent (22% P_2O_5), increased 20% in 1977.

Salt.—Salt production increased from 5.5 million tons to an estimated 6 million tons in 1977. Most of the output (85%) came from five companies, all based in Western Australia. Output from South Australia, Victoria, and Queensland accounted for the remainder. Production was by solar evaporation, mainly of sea water but also of lake and delta brines. Exports, which accounted for about 70% of the production, also varied little over the same period. The salt was sold under long-term contracts to Japanese buyers.

Companies in Western Australia (mainly Texada Mines Ltd., Dampier Salt Ltd., Leslie Salt Co., Lefroy Salt Pty. Ltd., and Shark Bay Salt Pty. Ltd.), produced 4.1 million tons of salt, valued at approximately $27 million. BHP, through its subsidiary Dampier Mining Co. Ltd., had a 76% interest in Texada Mines Ltd., one of Australia's largest producers of evaporative salt. BHP's purchase of Texada made it the first major salt exporter to have a majority Australian ownership. From one section of the field, Texada's salt came from brine that saturated the bed of Lake McLeod, the surface of which is normally dry. The lake, which is 110 kilometers long and 40 kilometers across at its widest section, is 65 kilometers north of Carnarvon. It covered an area of 225,000 hectares. The strata below the lake consisted of a layer of impure gypsum approximately 2 meters thick, underlain by halite (rock salt) varying in depth to 15 meters. The volume of halite was estimated to exceed 3 million tons.

The halite was impregnated with saturated brine that contained about 21% sodium chloride. The brine was extracted from the halite bed by large-capacity pumps and flowed to the crystallizing pan area. Approximately 25 crystallizer pans, covering an area of 800 hectares, were used for production. Each pan was harvested once a year, with salt deposited about 300 millimeters thick. Harvesting proceeded throughout the year as various pans were cleared in sequence and then refilled with brine.

Leslie Salt at Port Hedland, Western Australia, produced 1.6 million tons of salt, a slight increase over that for 1976. The workforce was increased to 88, and work was commenced to increase crystallizer capacity by approximately 20%. The company shipped to markets in the Philippines, the Republic of South Africa, Japan, Korea, New Zealand, and Taiwan.

Lefroy Salt produced about 115,000 tons of salt from its operations on Lake Lefroy. Construction of additional facilities to increase washing capacity to 500,000 tons annually was completed.

South Australia produced 560,000 tons of salt, slightly less than in 1976. The State's principal producer, Imperial Chemical Industries of Australia and New Zealand Ltd. (ICIANZ) at Dry Creek, produced about 300,000 tons. The company used the output for manufacturing sodium carbonate and sodium hydroxide. Waratah Gypsum Pty. Ltd., at Whyalla, reported production of about 85,000 tons of salt from the brines of Lake MacDonnell. The two companies accounted for about 69% of the State's output. Waratah Gypsum reported that although it had lost its export market in Southeast Asia, domestic sales had increased to more than offset these losses. BHP produced about 75,000 tons of salt from sea water at Whyalla. Salt production by Australian Salt Co. Ltd. at Lake Bumbunga and by Ocean Salt Pty. Ltd. at Price was around 20,000 tons and 50,000 tons, respectively.

Queensland produced 115,000 tons of salt during the year. The companies that contributed to the output were Central Queensland Salt Industries Ltd. (29,000 tons) and Imperial Chemical Industries Australia Ltd. (85,000 tons). Both recovered salt from naturally occurring underground brine at Bajoal, about 30 kilometers south of Rockhampton.

Sulfur.—There were no known deposits of elemental sulfur in Australia; demand for sulfur was met mainly from imports. Sulfur was consumed mainly (93%) in the form of sulfuric acid to produce fertilizer, particularly superphosphate. About 70% of sulfuric acid production was from imported brimstone and 30% from indigenous raw materials, principally zinc, pyrite, and lead concentrates. Sulfur was obtained from petroleum by Petroleum Refineries (Australia) Pty. Ltd. at Altona, Victoria, and Hallett's Cove, South Australia; Shell Refining (Australia) Pty. Ltd. at Clyde, New South Wales, and Geelong, Victoria; Australian Oil Refining Pty. Ltd. at Kernell, New South Wales; and Amoco (Australia) Pty. Ltd. at Bulwer Island, Queensland. The combined capacity of the plants was about 52,000 tons per year, but actual production depended on the sulfur content of the refinery feedstock. Output has been declining since low-sulfur Bass Strait oil began replacing high-sulfur imported crude oil. To-

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tal production of sulfur from petroleum in 1977 was about 7,000 tons.

Pyrite for sulfuric acid manufacture was produced only as a byproduct of base-metal mining in Tasmania by EZ Co. and the Mount Lyell Mining & Railway Co. Ltd. The acid was produced at Burnie, Tasmania, by North-West Acid Pty. Ltd., a company jointly owned by the two pyrite producing companies. The output by North-West Acid totaled 318,074 tons of sulfuric acid in 1977, compared with 275,324 tons in 1976. The production at only about 75% of designed plant capacity was attributable to the continuation of plant operating difficulties.

Some exploration was done on pyritic black slate occurrences near Port Sorell and at Dial Range, both located in Tasmania. Tin deposits at Mount Bischoff and Renison Bell were associated with enormous deposits of pyrite and pyrrhotite and were being investigated.

MINERAL FUELS

Coal.—Domestic production of black coal was 4% above that of 1976. Expansion of the coal industry had been spectacular, and the value of exports increased tenfold since 1966. Much of this expansion was centered on large-scale and comparatively low-cost open pit mines, which accounted for about 85% of Queensland's production in 1977. In New South Wales, underground mines continued to be the main source of supply, accounting for 79% of production. Although production from New South Wales collieries accounted for about 60% of Australia's total output, more than half of the coal exported was from Queensland.

The abolition of an export coal levy was accepted in the 1976 Federal budget, and legislation was passed to phase out the charge over a 3-year period. The levy on coking coal was reduced 25% to $4.50 per ton, and the levy on inferior grades of coal was reduced from $2.00 to $1.50 per ton.

The large resources of black coal occur mainly in the Bowen Basin and West Morton district in Queensland, the Sydney Basin in New South Wales, and the Collie field, Western Australia. Outside of these areas, a small amount of black coal was produced in northern Tasmania, and subbituminous coal was produced at Leigh Creek, South Australia. Extensive deposits of lignite in Victoria were used for power generation in the Latrobe Valley and at Angelsea.

Coal produced in New South Wales was bituminous, and nearly all was mined in the Sydney Basin. More than two-thirds was high-volatile soft coking coal and steaming coal, most of which was mined in the Newcastle and Singleton areas. Smaller quantities were mined in the southern Maitland area and in the Western District around Leithgow. The low- and medium-volatile coals (premium hard-coking coals) were mined on the south coast and in the Burragorang Valley. Some high-volatile coal was mined on the north of the Sydney Basin at Gunnedah. The expansion program was vigorously maintained. To assist this expansion in New South Wales, the Government announced the construction of a $200 million coal-loading facility at Port Kembla and an extension of existing facilities in Sydney.

In Queensland, the main thrust was towards development of large deposits of coking coal for export. The Norwich Park project of Utah Development Co. (owned 89.2% by Utah International Inc. of the United States and 10.8% by Utah Mining Australia Ltd.) was started during 1977. However, work was suspended in July when the company came into conflict with the Seaman's Union over the manning of ships. The company obtained an injunction under which the union had to supply tugs until the dispute could be resolved in the Federal Court, and contract work at Norwich Park was resumed late in the year. The Hail Creek and Nebo development projects were not initiated.

The Gregory project, controlled by the BHP Co., moved a step nearer fruition when the company obtained a $1.4 billion contract to supply 27 million tons of coking coal to Japan over a period of 14 years. The mine, rail link, and port facilities at Gladstone were estimated to cost $350 million.

The Queensland Government granted exploration rights over two attractive prospects (German Creek and Oaky Creek) in the Bowen Basin. Proved resources at German Creek were 361 million tons, and planned production was on the order of 3 million tons per year from underground development. Rights were held by Capricorn Coal Development Pty. Ltd., in which the United Kingdom National Coal Board has a major interest. The Oaky Creek prospect, adjoining German Creek, was to be prospected by a partnership of Houston Oil and Minerals (80%) and R. W. Miller Holdings (20%), which was committed to spend $90 million over a period of 3 years.

The Collie field in Western Australia produced at a rate of more than 2 million

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tons per year, mainly for power generation. Production was to be increased to meet anticipated higher demand.

Nearly 80% of coal exports were to Japan. Modest price rises granted on some contracts helped to maintain coal at the head of the list of mineral exports in terms of value. Other destinations included the United Kingdom, Europe, and the Republic of Korea. Export contracts were signed with Pakistan and Brazil.

Black coal reserves were estimated at 229 billion tons of which 35 billion tons was indicated and 194 billion tons was inferred. Indicated reserves were located in New South Wales (16.2 billion tons), Queensland (15.8 billion tons), Western Australia (1.9 billion tons), South Australia (730 million tons), and Tasmania (143 million tons). Substantial deposits of coal have also been delineated in areas not being mined, notably in the Surat Basin (Queensland), at Lake Phillipson in the Arckaringa Basin (South Australia), and in the Corrabin-Oaklands Basin (New South Wales).

Lignite.—Victoria produced all of Australia's lignite during 1977. The major deposits were in the Latrobe Valley, 200 kilometers southeast of Melbourne. Deposits were also located at Angelsea, Bacchus Marsh, and Gelliondale. The State Electricity Commission (SEC) produced 29.3 million tons, more than 95% of the State's total output, at Yallowin and Morwell. Coal was won by large draglines with an excavating capacity of 2,000 tons per hour. The Yallowin open pit produced at a rate of 13 million tons per year. Traditionally, production from Yallowin was used to produce a high-grade solid fuel in briquet form for domestic and industrial use. However, briquets were used as a basis for the production of high-grade char, gas, liquid fuel products, and other chemical industry feedstocks.

The Victorian Parliamentary Public Works Committee did not make a decision on the proposed Loy Yang development program, which provided for development of an open pit mine to serve a 4,000-megawatt power station. The first stage, comprising a 2,000-megawatt station, was planned to come into service between 1983 and 1988, and the second stage between 1989 and 1992.

Brown coal reserves were estimated at 122 billion tons (67 billion tons indicated and 55 billion tons inferred). Victoria had 66.7 billion tons of indicated reserves (12.2 billion tons salable), and the rest was in the Saint Vincent Basin of South Australia.

Petroleum and Natural Gas.—Crude oil production showed an increase of 3% over that of 1976. Natural gas output was 13.5% over that of 1976. The Victorian offshore fields (Bass Strait) produced 145.1 million barrels of crude oil, 92.3% of total oil production. The remainder came from Barrow Island, Western Australia, and the nearly exhausted field at Moonie, Queensland. Total oil output represented only 70% of current domestic requirements but could decline to 30% by 1985 unless significant discoveries were made and in production by that time.

Output of marketable products from Australian petroleum refineries in 1977 increased 5% compared with that of 1976. Refinery input was 294 million barrels of crude oil and other refinery feedstock. Of this total, 210 million barrels was indigenous crude.

Output of motor spirit, automotive distillate, and fuel oil increased slightly. The combined output of these three products represented 71% of the total refinery output in 1977.

Consumption of marketable petroleum products totaled 27 million barrels, an increase of 4.5% over that of 1976. Gasoline consumption of 89.7 million barrels was 7.6% over the 1976 figure. Other major products consumed were fuel oil (40 million barrels, up 3.2%), industrial diesel fuel (11.9 million barrels, up 2.5%), and aviation turbine fuel (11.7 million barrels, up 0.9%).

On the exploration and development scene, the BHP and Esso Exploration & Production Australia Inc. brought the Victoria offshore (Bass Strait) Mackerel field into production and was working on bringing onstream the Tuna (oil) and Snapper (gas) fields, also offshore Victoria. Exploration drilling by BHP-Esso resulted in the discovery of the Cobia field (Bass Strait), which would be commercially viable at import parity prices. The partnership announced the recoverable reserves in the Bass Strait fields at 2.9 million barrels of liquids and 7.2 trillion cubic feet of gas.

Overall, the exploration drilling program offshore increased from 3 wells in 1976 to 13 in 1977. Onshore, exploration wells declined from 15 to 8 in the same period. Although further development drilling will take place in the gasfields in the Roma area of Queensland and in the Cooper Basin of South Australia, most activity in the near future will be in Western Australia. There,

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projects valued at many millions of dollars were expected by 1978. This upsurge was stimulated largely by the granting of permission to export gas from the Northwest Shelf, revised pricing arrangements, and tax concessions on investments in offshore exploration.

The largest single operation in Western Australia was on the Northwest Shelf, an area extending about 130 kilometers seaward and about 1,000 kilometers northeast from Barrow Island. This area includes the Rankin, Angel, and Goodwyn gas and condensate fields. A consortium comprising the BHP Co., Shell Oil Co., Woodside Petroleum Co., British Petroleum, and California Asiatic Oil Co. started a $50 million feasibility study that could lead to development. This would include construction of two production platforms, a pipeline to shore, processing and liquefaction plants, and a fleet of liquefied gas tanks, all at an estimated cost of $2.5 billion.

The initial recoverable primary and secondary reserves of crude oil were estimated to be 4 billion barrels as of June 30, 1977. The largest remaining reserves were in the offshore Gippsland Basin, amounting to 1.5 barrels, or 38% of the total. The recoverable primary and secondary reserves of natural gas on June 30, 1977, were estimated at 31 trillion cubic feet, an increase of 5% over that of 1976. This was attributed to an increase in the estimated reserves of the Northwest Shelf by the addition of the Tern and Spar Fields.

Uranium.—Mary Kathleen Uranium Ltd. (MKU), which commenced operation in 1976, remained Australia's only operating uranium mine. Production in the first half of 1977 was affected by technical problems, and a total output for the year was 420 tons of uranium oxide (U_3O_8). This quantity was inadequate to meet contract commitments, and some yellow cake (U_3O_8 concentrate) was borrowed from the government stockpile. Shipments were disrupted by a labor strike and this, together with production and marketing problems, caused a loss in excess of $15 million during the year.

The second, and final, report of the Ranger Environmental Inquiry was released in May. The 415-page report included 143 major recommendations that were applicable to a broad spectrum of issues concerning the development of the uranium industry. The principal findings and recommendations were as follows: (1) The hazards of mining and milling uranium, if those activities are properly regulated and controlled, were not such as to justify a decision not to develop Australian uranium mines; (2) the hazards involved in the ordinary operations of nuclear power reactors, if those operations were properly regulated and controlled, were not such as to justify a decision not to mine and sell Australian uranium; (3) any development of Australian uranium mines should be strictly regulated and controlled; and (4) no sales of Australian uranium should take place to any country not party to the nonproliferation treaty. Exports should be subject to the fullest and most effective safeguard agreements and be supported by fully adequate backup agreements applying to the entire civil nuclear industry in the country supplied.

In late August, the Commonwealth Government announced its decision on the mining and export of Australian uranium. The decision was that mining could proceed if and when the following conditions had been satisfied: (1) The mining operations must conform with a mandatory code of practice which the Government shall progressively prescribe; (2) the requirements of the Environmental Protection (Impact of Proposals) Act 1974 must be complied with; (3) the Government must be satisfied as to the acceptability of the development on the environment and on the Aboriginal people; and (4) uranium sale contracts must conform with the Government's safeguards policy. The announcement indicated that the Government's decision would enhance other uranium development throughout the Commonwealth, as well as in the Northern Territory.

Measured reserves in four large deposits in the Northern Territory total 297,000 tons U_3O_8 comprising Jabiluka (172,000 tons), Ranger (100,000 tons), Koongarra (15,000 tons), and Nabarlek (10,000) tons. The planned initial rate of production was 9,000 tons per year.

The Yeelirrie deposit in Western Australia has measured reserves of 46,000 tons U_3O_8, the Beverley and Mount Painter deposits in South Australia have 16,000 tons, and remaining reserves at Mary Kathleen were about 8,000 tons. This total of 367,000 tons U_3O_8 in seven deposits was considered available for immediate development. With numerous other prospects under investigation throughout the country, Australia was expected to become a major uranium producer.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Australian dollars ($A) to U.S. dollars at the rate of $A1.00=US$1.12.

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The Mineral Industry of Austria

By William F. Keyes[1]

Austria's recovery from the 1975 recession, which was so hopeful in 1976, started leveling off in 1977. Industrial production was stagnant after the first quarter. Exports rose, but imports rose faster, resulting in a further growth in the foreign trade deficit to an estimated $4 billion[2] for the year.

Basic industry was especially affected by the decline. Orders for nonferrous metal manufactures and iron and steel products were about 25% below those of the previous year, and measures to introduce shorter working hours and reduce employment were underway.

Austria's mineral economy consists of fairly large-scale mining of iron ore, petroleum and natural gas, and magnesite; there is production of iron and steel, base metals, and refined petroleum products on a scale to virtually supply domestic needs. During the year, an iron blast furnace was inaugurated, work on a new lignite mine started, two major natural gas pipelines were planned, and petroleum exploration moved into a new phase of deeper drilling.

PRODUCTION

Mineral production followed the general economy and showed mixed trends. There were moderate gains in production of primary aluminum, refined copper, cement, graphite, crude magnesite, and natural gas, and moderate declines in output of iron and steel, lead, manganese, and salt.

Table 1.—Austria: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Aluminum metal:			
Primary	88,848	88,670	91,815
Secondary	22,244	49,235	39,773
Antimony, mine output, metal content	555	564	561
Cadmium metal	30	29	26
Copper:			
Mine output, metal content	1,983	1,175	--
Metal, refined, including secondary	26,931	28,589	31,707
Germanium, content of concentrate kilograms	4,400	4,700	4,000
Iron and steel:			
Ore and concentrate, gross weight thousand tons	3,833	3,784	3,449
Metal:			
Pig iron do	3,056	3,318	2,965
Ferroalloys (electric furnace) do	7	8	7
Crude steel do	4,068	4,477	4,093
Semimanufactures do	3,012	3,510	3,348
Lead metal, smelter:			
Primary	9,362	9,100	7,303

See footnotes at end of table.

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Table 1.—Austria: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS —Continued			
Lead metal, smelter —Continued			
Secondary	5,779	7,609	10,626
Manganese, Mn content of domestic iron ore	72,768	70,595	64,734
Tungsten, mine output, metal content	362	541	1,116
Zinc:			
Mine output, metal content	23,040	22,651	22,037
Metal, refined	16,273	16,574	16,774
NONMETALS			
Barite	279	81	192
Cement, hydraulic thousand tons	5,630	5,880	5,993
Clays:			
Illite	382,599	297,663	464,888
Kaolin:			
Crude	281,200	270,742	272,250
Marketable	75,187	71,579	74,147
Other[1]	55,221	41,896	68,060
Diatomite	1,570	1,882	242
Feldspar, crude	--	3,800	3,645
Graphite, crude	30,586	33,057	35,288
Gypsum and anhydrite, crude thousand tons	715	770	809
Lime do	947	959	969
Magnesite:			
Crude thousand tons	1,266	927	1,003
Sintered or dead-burned do	471	401	372
Caustic calcined do	142	125	123
Pigments, mineral: Micaceous iron oxide	8,722	10,627	9,805
Pumice (trass)	12,677	11,682	8,847
Salt:			
Rock thousand tons	1	1	1
In brine:			
Evaporated do	258	332	323
Other do	206	245	146
Total do	464	577	469
Sand and gravel:			
Quartz sand do	825	801	872
Industrial sand do	293	140	NA
Other sand and gravel do	8,015	8,092	8,329
Stone:[2]			
Dimension stone do	92	61	NA
Quartz and quartzite do	159	205	155
Other quarry stone and broken stone do	1,634	1,912	NA
Sulfur:			
Byproduct do	25	26	25
From gypsum and anhydrite do	28	23	27
Total do	53	49	52
Talc and soapstone	86,512	100,649	103,743
MINERAL FUELS AND RELATED MATERIALS			
Coal, brown, and lignite thousand tons	3,397	3,215	3,127
Coke:			
Breeze do	342	NA	NA
Metallurgical do	1,265	NA	NA
Total do	1,607	1,615	1,458
Gas:			
Manufactured, all types[3] million cubic feet	e77,000	NA	NA
Natural:			
Gross do	83,305	75,721	84,502
Marketed do	79,869	69,093	e79,432
Natural gas liquids, condensate thousand 42-gallon barrels	182	191	e190
Oil shale	1,360	930	420
Petroleum:			
Crude thousand 42-gallon barrels	14,205	13,466	12,462
Refinery products:			
Gasoline do	12,671	14,295	12,903
Jet fuel do	572	1,135	732
Kerosine do	48	96	183
Distillate fuel oil do	15,656	18,345	17,546
Residual fuel oil do	22,309	25,683	23,684
Lubricants do	1,031	1,221	1,198
Liquefied petroleum gas do	1,176	1,334	1,414
Bitumen do	2,293	2,127	2,385
Other do	3,369	3,364	3,591

See footnotes at end of table.

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Table 1.—Austria: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum —Continued			
Refinery products —Continued			
Refinery fuel and losses ---------- thousand 42-gallon barrels	2,351	2,313	2,524
Total ---------- do	61,476	69,913	66,160

[e]Estimate. [p] Preliminary. NA Not available.
[1]Excluding clay sand.
[2]Excluding stone used by the cement and iron and steel industries.
[3]Including blast furnace and coke oven gas. Manufactured gas is reported in source as gas having a calorific value of 4,200 calories per cubic meter.

TRADE

Austria is an importer of most major nonferrous metals and iron ore. From the United States it imports phosphate rock and clays and refractories, exchanging for these moderate but significant amounts of steel semimanufactures and some nonferrous metals. Trade with the United States in 1976 is shown in table 4.

Table 2.—Austria: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Oxide and hydroxide (includes manufactured corundum) ----------	19,954	30,636	United Kingdom 5,168; Italy 4,944; West Germany 4,702; Poland 3,260.
Metal including alloys:			
Scrap ----------	20,073	30,419	Italy 16,688; West Germany 13,190.
Unwrought ----------	8,536	8,589	West Germany 5,471; Italy 1,058; Turkey 902.
Semimanufactures ----------	r38,176	57,734	West Germany 10,615.
Antimony ore and concentrate ----------	329	488	NA.
Cadmium metal including alloys, all forms kilograms	200	15,100	U.S.S.R. 10,000; United Kingdom 5,000.
Chromium:			
Chromite ----------	177	294	West Germany 266.
Oxide ----------	11	17	West Germany 15.
Columbium and tantalum: Tantalum metal including alloys, all forms ---------- kilograms	7,100	27,800	NA.
Copper:			
Ore and concentrate ----------	2,236	1,246	Mainly to Romania.
Copper sulfate ----------	186	72	United States 40; West Germany 20; Romania 12.
Metal including alloys, all forms:			
Scrap ----------	622	704	West Germany 402; Switzerland 115; Hungary 90.
Unwrought ----------	r10,932	13,817	West Germany 10,978; Switzerland 1,768.
Semimanufactures ----------	6,538	7,579	France 1,235; Sweden 936.
Gold metal, unworked or partly worked troy ounces	19,644	8,584	West Germany 7,266.
Iron and steel:			
Ore and concentrate, except roasted pyrite ----------	1,131	1,710	Belgium-Luxembourg 1,200; West Germany 410.
Metal:			
Scrap ----------	50,482	43,806	Italy 33,489; Switzerland 4,510.
Pig iron, ferroalloys, similar materials thousand tons	13	12	Poland 2; West Germany 1.
Steel, primary forms ---------- do	364	386	West Germany 216; Italy 92; Poland 43.
Semimanufactures:			
Bars, rods, shapes, angles, sections do	273	294	Italy 84; West Germany 63; Poland 37.
Universals, plates, sheets ---- do	967	936	West Germany 288; Italy 102.
Hoop and strip ---------- do	78	97	Switzerland 22; West Germany 17; Poland 9.
Rails and accessories ---------- do	96	111	Iran 33; Poland 30; Switzerland 21.
Wire ---------- do	40	53	West Germany 10; Switzerland 8; Hungary 5; Poland 5; Sweden 5.

See footnotes at end of table.

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Table 2.—Austria: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Iron and steel —Continued			
Metal —Continued			
Semimanufactures —Continued			
Tubes, pipes, fittings thousand tons	154	153	West Germany 34; Sweden 31; United Kingdom 22; Denmark 12.
Castings and forgings, rough do	8	8	Netherlands 1; Sweden 1; Switzerland 1.
Lead:			
Oxide	3,023	3,583	Hungary 1,465; U.S.S.R. 1,315; Yugoslavia 721.
Metal including alloys, all forms	1,042	1,081	Yugoslavia 696; West Germany 226; Hungary 130.
Magnesium metal including alloys, all forms	238	513	West Germany 352.
Manganese oxide	473	310	Brazil 275.
Mercury 76-pound flasks	380	360	West Germany 212; Thailand 38.
Molybdenum metal including alloys, all forms	569	763	NA.
Nickel metal including alloys, all forms	181	--	
Platinum-group and silver metals including alloys, all forms:			
Platinum-group troy ounces	41,442	9,420	Romania 4,662; West Germany 3,922.
Silver:			
Bullion do	r385,808	543,347	West Germany 392,239; Yugoslavia 151,108.
Powder do	r6,430	3,215	All to West Germany.
Semimanufactures do	r311,862	324,722	Yugoslavia 295,786.
Tin:			
Oxide	31	19	Bulgaria 10; Turkey 6; Yugoslavia 3.
Metal including alloys, all forms	42	53	Denmark 33; United Kingdom 9; Greece 4.
Titanium oxide	14	7	NA.
Tungsten:			
Ore and concentrate	30	450	All to West Germany.
Metal including alloys, all forms	150	183	NA.
Zinc:			
Ore and concentrate	4,632	6,456	Romania 3,003; Italy 1,897; West Germany 1,555.
Oxide	416	471	Hungary 200; West Germany 121; Netherlands 60.
Metal including alloys, all forms	r406	232	West Germany 180; Italy 31.
Other:			
Ores and concentrates	417	111	West Germany 66; Turkey 40.
Ash and residue containing nonferrous metals	40,325	54,263	Italy 39,750; West Germany 12,377.
Waste and sweepings of precious metals kilograms	30,475	26,861	Mainly to West Germany.
Oxides, hydroxides, peroxides of metals	443	288	Italy 125; Belgium-Luxembourg 116; West Germany 28.
Base metals including alloys, all forms	1,566	1,760	United Kingdom 1,471.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, other	1	82	Honduras 80.
Grinding and polishing wheels and stones	11,625	11,174	Poland 1,579; Romania 1,317; West Germany 1,273.
Asbestos	183	449	Nigeria 439.
Cement	29,931	50,249	Yugoslavia 24,174; West Germany 17,489; U.S.S.R. 7,000.
Chalk	3,042	2,766	Hungary 1,320; Yugoslavia 568; Italy 493.
Clays and clay products (including all refractory brick):			
Crude:			
Kaolin (china clay)	13,188	16,630	Italy 11,970; Switzerland 1,637.
Other	r357	276	Hungary 155; U.S.S.R. 37.
Products:			
Refractory (including nonclay brick)	272,624	187,172	West Germany 36,983; France 35,843; Poland 17,243.
Nonrefractory	1,931	6,607	West Germany 5,138; East Germany 666.
Diamond, industrial value	--	$111	NA.
Diatomite and other infusorial earth	729	681	Yugoslavia 515.
Feldspar	100	(1)	NA.
Fertilizer materials:			
Crude, unspecified	r40	61	West Germany 59.
Manufactured, phosphatic	r66,376	37,649	Hungary 34,751.
Graphite, natural	15,500	16,374	Poland 7,146; West Germany 5,910.
Gypsum and plasters	r127,558	56,842	West Germany 44,318; Italy 12,514.
Lime	16,122	21,144	Hungary 20,185.
Magnesite	r125,182	49,263	Switzerland 2,857; Hungary 1,879.
Mica, all forms	r44	123	Sweden 43; West Germany 28; Poland 13.
Pigments, mineral, including processed iron oxides	5,533	6,928	West Germany 1,772; United Kingdom 1,708.
Precious and semiprecious stones, including diamond:			
Natural kilograms	1,589	1,848	NA.

See footnotes at end of table.

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Table 2.—Austria: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Precious and semiprecious stones, including diamond —Continued			
Manufactured ____ kilograms	1,339	2,045	NA.
Pyrite	--	20	All to Italy.
Salt	16	223	Denmark 160; Poland 61.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous, including marble and limestone	70,795	67,025	West Germany 59,404.
Slate	58	22	NA.
Other	r60,308	47,360	Mainly to West Germany.
Worked:			
Paving stone and flagstone	4,615	3,841	Switzerland 2,873.
Slate	11	29	Mainly to Switzerland.
Other	r2,747	1,917	West Germany 1,280.
Dolomite	r3,144	7,566	West Germany 5,444.
Gravel and crushed rock	r365,854	339,996	Switzerland 213,627; West Germany 122,557.
Limestone	19	166	All to West Germany.
Quartz and quartzite	1,108	506	Hungary 270; U.S.S.R. 120; Italy 80.
Sand, excluding metal bearing	105,920	104,349	West Germany 57,350; Switzerland 32,547.
Sulfuric acid (including oleum)	1,338	7,105	Italy 3,289; West Germany 3,115.
Talc, steatite, soapstone, pyrophyllite	72,732	85,032	West Germany 41,269; Italy 10,991; Netherlands 7,642.
Other:			
Crude	4,563	4,542	West Germany 4,045.
Slag, dross, and similar waste, not metal bearing	44,093	35,975	West Germany 20,261; Italy 9,505; Czechoslovakia 6,085.
Oxides and hydroxides of magnesium, strontium, barium	51	3	NA.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	23	6	NA.
Carbon black and gas carbon	43	17	NA.
Coal and coal briquets:			
Anthracite and bituminous	18	1	NA.
Lignite	9,994	9,035	Mainly to West Germany.
Coke and semicoke	r13,414	63,817	Mainly to Romania.
Gas, manufactured ____ thousand tons	34	41	U.S.S.R. 32; West Germany 5.
Hydrogen, helium, rare gases thousand cubic feet	10,303	43,369	Hungary 28,247; West Germany 12,298.
Peat, including peat briquets and litter	15	--	
Petroleum refinery products:			
Gasoline, aviation and motor thousand 42-gallon barrels	44	260	Mainly to Poland.
Kerosine and jet fuel ____ do	(1)	(1)	NA.
Distillate fuel oil ____ do	77	1	Mainly to Czechoslovakia.
Residual fuel oil ____ do	122	163	Czechoslovakia 114; Poland 48.
Lubricants ____ do	647	691	Czechoslovakia 279; Poland 268.
Other ____ do	52	58	Yugoslavia 40; Poland 6.
Total ____ do	942	1,173	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	14,317	15,712	West Germany 8,854; Yugoslavia 3,580.

rRevised. NA Not available.
1Less than 1/2 unit.

Table 3.—Austria: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite	18,947	30,878	NA.
Oxide and hydroxide	201,277	205,054	West Germany 11,781; France 2,914; United States 715.
Metal including alloys:			
Scrap	14,120	24,145	U.S.S.R. 10,709; Poland 10,340.

See footnotes at end of table.

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Table 3.—Austria: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
Aluminum —Continued			
Metal including alloys —Continued			
Unwrought	17,994	21,040	West Germany 6,087; Hungary 5,683; Norway 4,629.
Semimanufactures	17,091	24,116	West Germany 13,665; Switzerland 5,248; Yugoslavia 1,143.
Antimony:			
Ore and concentrate	154	--	--
Metal including alloys, all forms	97	171	Belgium-Luxembourg 59; Italy 56; Denmark 41.
Arsenic trioxide, pentoxide, and acids	43	41	France 21.
Cadmium metal including alloys, all forms	1	2	West Germany 2.
Chromium:			
Chromite	123,138	62,765	Turkey 10,093; Iran 7,989; Philippines 5,756.
Oxide and hydroxide	294	338	West Germany 178; Czechoslovakia 77; Poland 40.
Cobalt oxide and hydroxide kilograms	500	3,200	West Germany 2,600.
Columbium and tantalum: Tantalum metal including alloys, all forms do	15,900	11,600	West Germany 8,500; United States 2,900; Netherlands 200.
Copper:			
Ore and concentrate	22	51	West Germany 48.
Copper sulfate	148	313	France 102; Switzerland 65; Belgium-Luxembourg 60.
Metal including alloys:			
Scrap	11,904	12,939	West Germany 7,834; Switzerland 2,460; Poland 1,542.
Unwrought	25,019	22,030	West Germany 7,008; Italy 1,744; Belgium-Luxembourg 1,008.
Semimanufactures	16,377	26,861	West Germany 13,618; United Kingdom 7,470; Sweden 2,075.
Gold metal, unworked or partly worked thousand troy ounces	292	966	Switzerland 800; Republic of South Africa 103.
Iron and steel:			
Ore and concentrate, except roasted pyrite thousand tons	2,578	2,876	U.S.S.R. 594; Liberia 434; Canada 290.
Roasted pyrite do	181	119	Italy 82; West Germany 26; Yugoslavia 6.
Metal:			
Scrap do	33	45	West Germany 19; East Germany 10; Czechoslovakia 6.
Pig iron, including cast iron and similar materials[1] do	52	108	Hungary 42; U.S.S.R. 28; West Germany 26.
Ferroalloys:			
Ferromanganese do	21	21	Norway 16; West Germany 2.
Other do	40	50	Republic of South Africa 11; Norway 8; U.S.S.R. 7.
Steel, primary forms do	84	140	West Germany 38; U.S.S.R. 30; Poland 21.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	118	170	West Germany 82; Italy 46; Switzerland 18.
Universals, plates, sheets do	110	152	West Germany 82; France 16; Belgium-Luxembourg 11.
Hoop and strip do	22	38	West Germany 22; Switzerland 6; Sweden 3.
Rails and accessories do	6	3	West Germany 2.
Wire do	14	15	West Germany 5; Belgium-Luxembourg 4; Italy 1.
Tubes, pipes, fittings do	139	133	West Germany 78; Italy 14; Switzerland 13.
Castings and forgings, rough do	8	8	West Germany 6; Belgium-Luxembourg 1.
Lead:			
Ore and concentrate	7,424	7,561	Italy 5,450; Canada 2,101.
Oxide	90	108	Switzerland 91; West Germany 16.
Metal including alloys:			
Scrap	1,608	2,435	Switzerland 1,422.
Unwrought	15,909	22,999	Yugoslavia 14,939; West Germany 3,210; East Germany 1,073.
Semimanufactures	243	311	West Germany 259.
Magnesium metal including alloys, all forms	1,067	2,099	Norway 1,427; West Germany 184; U.S.S.R. 172.
Manganese:			
Ore and concentrate	479	573	Morocco 300; Netherlands 172.
Oxide	198	166	United States 105; West Germany 56.
Mercury 76-pound flasks	1,790	992	Italy 235; Spain 200; United States 160.
Molybdenum:			
Oxide	688	1,421	NA.

See footnotes at end of table.

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Table 3.—Austria: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
Molybdenum —Continued			
Metal including alloys, all forms	570	51	Mainly from West Germany.
Nickel:			
Matte, speiss, similar materials	904	1,165	Cuba 569; United States 434; Netherlands 139.
Metal including alloys:			
Scrap	1,056	902	U.S.S.R. 505; West Germany 187; Netherlands 142.
Unwrought	1,904	2,255	Philippines 501; United Kingdom 465; Australia 306.
Semimanufactures	820	1,021	West Germany 602; United Kingdom 239; Australia 75.
Platinum-group and silver metals including alloys, all forms:			
Platinum-group troy ounces	26,331	25,946	West Germany 21,734; United Kingdom 2,379; Switzerland 1,800.
Silver:			
Bullion thousand troy ounces	5,343	6,025	West Germany 1,563; United Kingdom 1,514; Mexico 1,206.
Powder do	3	10	All from West Germany.
Semimanufactures do	8,144	3,868	West Germany 3,202; Switzerland 431.
Tin metal including alloys, all forms	479	555	West Germany 158; Thailand 158.
Titanium oxide	7,228	9,091	West Germany 5,955; Italy 1,045; United Kingdom 909.
Tungsten:			
Ore and concentrate	1,717	2,722	People's Republic of China 1,043; Australia 669; Brazil 284.
Oxide and hydroxide	204	311	NA.
Metal including alloys, all forms	196	296	West Germany 112; Republic of Korea 68; Belgium-Luxembourg 45.
Zinc:			
Ore and concentrate	128	7	NA
Oxide	504	791	West Germany 483; U.S.S.R. 170.
Metal including alloys:			
Scrap and blue powder	550	742	Belgium-Luxembourg 240; United Kingdom 203; Hungary 113.
Unwrought	7,571	5,237	West Germany 2,754; Italy 704; Bulgaria 640.
Semimanufactures	922	1,342	West Germany 1,086; Yugoslavia 130.
Other:			
Ores and concentrates	8,504	9,591	United States 4,401; Chile 1,735; West Germany 499.
Ash and residue containing nonferrous metals	69,131	81,690	U.S.S.R. 35,428; East Germany 17,735; Poland 11,877.
Waste and sweepings of precious metals kilograms	147	32,287	Mainly from West Germany.
Oxides, hydroxides, and peroxides of metals	1,493	3,344	United States 1.719; Republic of South Africa 1,312.
Base metals including alloys, all forms	4,030	1,679	U.S.S.R. 486; Belgium-Luxembourg 365; West Germany 264.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, other	602	720	West Germany 492; Italy 115.
Dust and powder of precious and semiprecious stones, including diamond kilograms	27	138	Mainly from United States.
Grinding and polishing wheels and stones	837	905	West Germany 442; Italy 135; Belgium-Luxembourg 85.
Asbestos	34,343	38,552	Canada 17,778; U.S.S.R. 10,816.
Barite and witherite	3,288	4,008	West Germany 2,491; U.S.S.R. 1,494.
Boron materials:			
Crude natural borates	10,630	16,035	United States 8,095; Turkey 7,895.
Oxide and acid	1,465	971	France 566; Italy 217; Turkey 128.
Cement	50,582	34,726	West Germany 9,742; Italy 7,523; Yugoslavia 6,030.
Chalk	5,985	12,655	France 11,364; West Germany 1,025.
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite	629	541	West Germany 277; United States 245.
Kaolin (china clay)	73,043	89,085	U.S.S.R. 30,614; West Germany 23,424; United Kingdom 23,254; United States 10,383.
Other	90,125	83,954	West Germany 43,438; U.S.S.R. 30,036.
Products:			
Refractory (including nonclay brick)	23,209	22,390	Mainly from West Germany.

See footnotes at end of table.

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Table 3.—Austria: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Clays and clay products (including all refractory brick) —Continued			
Products —Continued			
Nonrefractory	192,602	230,949	Italy 134,315; West Germany 67,450.
Cryolite and chiolite, natural	269	246	Mainly from Denmark.
Diamond, industrial value	r$33,990	$83,445	Belgium-Luxembourg $38,016; West Germany $19,509; Netherlands $18,004.
Diatomite and other infusorial earth	5,675	6,474	Hungary 2,228; United States 1,427.
Feldspar	6,488	6,650	Sweden 3,045; West Germany 2,056; Italy 1,231.
Fertilizer materials:			
Crude:			
Phosphatic	408,316	307,866	United States 115,106; U.S.S.R. 85,248; Israel 54,482.
Potassic	19,256	19,982	East Germany 10,787; West Germany 9,170.
Other	1,251	2,150	West Germany 1,472; Italy 350; France 240.
Manufactured:			
Nitrogenous	6,781	37,013	West Germany 13,577; Czechoslovakia 11,392.
Phosphatic	91,254	80,949	France 43,775; Belgium-Luxembourg 32,989.
Potassic	r251,349	224,955	Mainly from West Germany.
Other, including mixed	3,590	4,364	West Germany 3,649; Belgium-Luxembourg 261.
Flourspar	14,533	14,609	East Germany 8,354; West Germany 5,035.
Graphite, natural	796	269	West Germany 192; North Korea 49.
Gypsum and plasters	8,146	11,403	West Germany 5,018; East Germany 3,574; Switzerland 2,131.
Lime	613	650	West Germany 384; Italy 140.
Magnesite	109,232	85,739	Turkey 28,373; West Germany 14,793; Australia 13,607.
Mica:			
Crude, including splittings and waste	257	296	West Germany 114; Norway 92; United Kingdom 65.
Worked, including agglomerated splittings	91	91	Belgium-Luxembourg 36; Switzerland 23.
Pigments, mineral:			
Natural, crude	159	217	France 111; West Germany 28.
Iron oxides, processed	2,351	2,552	Mainly from West Germany.
Precious and semiprecious stones, including diamond:			
Natural, crude thousand carats	94,980	141,370	West Germany 62,680; Brazil 47,185; Madagascar 14,020.
Manufactured do	28,695	52,280	Switzerland 38,675; France 11,170.
Pyrite, gross weight	13,558	13,874	U.S.S.R. 10,864; Italy 2,983.
Salt, including brine salt	460	32	All from West Germany.
Sand and gravel:			
Gravel (includes crushed rock)	173,087	203,565	West Germany 185,774; Italy 15,670.
Sand, excluding metal bearing	306,747	331,480	West Germany 214,720; Czechoslovakia 95,545.
Stone, n.e.s.:			
Dimension stone:			
Crude and partly worked:			
Calcareous, including marble and limestone	9,163	8,764	Italy 5,670; West Germany 1,585.
Slate	2,293	1,990	France 732; Sweden 395; West Germany 218.
Other	28,187	31,378	Italy 20,493; Republic of South Africa 4,721; Sweden 1,319.
Worked:			
Paving stone and flagstone	9,924	10,390	Italy 4,353; Romania 2,059; Yugoslavia 2,020.
Slate	506	382	Italy 177; Sweden 67; West Germany 46.
Dolomite, chiefly refractory grade	4,582	4,415	Italy 2,520; Norway 1,245; West Germany 448.
Limestone, except dimension	566	290	All from West Germany.
Quartz and quartzite	19,586	22,925	West Germany 16,391; Hungary 5,005.
Volcanic material (trass)	726	335	West Germany 310.
Sulfur:			
Elemental, all forms	112,356	84,338	Poland 44,069; West Germany 29,129.
Sulfur dioxide	2,830	4,370	West Germany 2,838; Switzerland 1,319.
Sulfuric acid (including oleum)	21,320	1,835	Mainly from West Germany.
Talc, steatite, soapstone, pyrophyllite	1,141	1,901	Norway 706; Italy 657; Belgium-Luxembourg 260.
Other:			
Crude:			
Meerschaum, amber, jet	4	13	NA.

See footnotes at end of table.

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Table 3.—Austria: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Other —Continued			
Crude —Continued			
Other	47,897	53,142	West Germany 24,602; Hungary 21,563.
Slag, dross, and similar waste, not metal bearing	31,980	29,630	Italy 14,496; West Germany 3,991.
Oxides and hydroxides of magnesium, strontium, barium	508	620	Mainly from West Germany.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	571	509	Trinidad and Tobago 300; United States 82; West Germany 55.
Carbon black and gas carbon	20,866	21,212	West Germany 11,081; Italy 8,735.
Coal and coal briquets:			
Anthracite and bituminous _ thousand tons	259	264	Poland 98; U.S.S.R. 73; Czechoslovakia 64.
Lignite do	675	597	Yugoslavia 211; East Germany; 192; West Germany 135.
Coke and semicoke do	989	1,099	Czechoslovakia 443; Poland 317; West Germany 235.
Gas, natural do	1,440	2,126	Mainly from U.S.S.R.
Hydrogen, helium and rare gases:[2]			
Hydrogen thousand cubic feet	5,140	4,016	Mainly from West Germany.
Argon do	35,627	41,348	Do.
Other kilograms	1,500	1,900	Do.
Peat, including peat briquets and litter	36,479	33,441	West Germany 17,589; U.S.S.R. 7,974; Poland 4,626.
Petroleum:			
Crude and partly refined:			
Crude thousand 42-gallon barrels	r45,046	53,972	Iraq 19,128; U.S.S.R. 11,445; Iran 7,780.
Partly refined do	274	530	Mainly from Hungary.
Refinery products:			
Gasoline, motor do	6,426	6,185	Italy 3,087; West Germany 1,923.
Kerosine do	11	23	Italy 8; France 5.
Distillate fuel oil do	903	815	Italy 314; West Germany 246; East Germany 114.
Residual fuel oil do	7,726	9,051	West Germany 2,604; Poland 1,559; Italy 1,514.
Lubricants do	866	1,239	Hungary 435; Poland 180; West Germany 141.
Mineral jelly and wax do	87	116	West Germany 67; East Germany 15; Hungary 12.
Other do	(3)	1,968	West Germany 1,051; Italy 717.
Total do	r16,019	19,397	
Mineral tar and other coal, petroleum, or gas derived crude chemicals	r17,308	20,986	West Germany 4,863; Czechoslovakia 4,073; Netherlands 2,818.

rRevised. NA Not available.

[1]Includes spiegeleisen, powder, sponge, and shot.

[2]Excludes small amounts of helium, neon, krypton, radon, and xenon totaling 1.5 metric tons in 1975 and 1,9 metric tons in 1976.

[3]Revised to none.

Table 4.—Austria: Mineral trade with the United States, 1976[1]

Commodity	Exports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
METALS				
Aluminum metal including alloys	2,777	$3,759	122	$198
Copper metal including alloys	620	577	5	33
Iron and steel metal:				
Ferroalloys	130	1,963	2	16
Steel, primary forms	--	--	(2)	2

See footnotes at end of table.

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Table 4.—Austria: Mineral trade with the United States, 1976[1] —Continued

Commodity	Exports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
METALS —Continued				
Iron and steel metal —Continued				
Semimanufactures:				
Bars and angles	4,085	5,153	12	69
Plates and sheets	5,345	2,032	82	225
Hoop and strip	164	390	3	11
Rails	1,933	453	--	--
Wire	216	137	14	60
Tubes and pipes	434	907	25	163
Castings and forgings	--	--	19	55
Lead metal including alloys	--	--	12	20
Nickel metal including alloys	60	374	5	108
Radioactive and associated materials	--	--	2	15
Tin metal including alloys	18	123	(2)	2
Other nonferrous metals:				
Ores and concentrates, n.e.s	2	8	119	400
Metals:				
Base metals including alloys, n.e.s	72	1,175	38	553
Scrap	81	76	39	31
NONMETALS				
Abrasives, natural, including diamond	NA	1	2,468	205
Clays and refractory materials	3,180	420	9,497	1,103
Diamond and precious stones	NA	299	(2)	72
Fertilizer materials, crude, phosphatic	--	--	97,430	4,173
Quartz, mica, feldspar, etc	5	5	--	--
Stone, dimension, n.e.s	194	154	--	--
Other, crude	--	--	301	256
MINERAL FUELS AND RELATED MATERIALS				
Petroleum refinery products: Lubricants	NA	(2)	122	129
Total	XX	18,006	XX	7,899

NA Not available. XX Not applicable.
[1]Data may differ from those reported elsewhere in this chapter owing to a difference in source.
[2]Less than 1/2 unit.

Sources: U.S. Department of Commerce, Bureau of the Census.

COMMODITY REVIEW

METALS

Aluminum.—Capacity of the two Austrian aluminum smelters remained unchanged. Vereinigte Metallwerke Ranshofen-Berndorf AG's (VMW) capacity at Ranshofen was 80,000 tons per year, and that of Salzburger Aluminium GmbH at Lend was 12,000 tons; production was near capacity at both plants.

Exports, largely by Salzburger, and imports, largely by VMW from its subsidiary in Hamburg, Federal Republic of Germany, were both relatively moderate. In the 1970's, Austria has gone from a small net exporter of aluminum to a small net importer. This trend should be confirmed by a decision of the Renault automobile company to switch production of aluminum pressure castings from France to Austria in 1978.

Iron and Steel.—After modest growth in 1976, steel production again declined in 1977. Late in the year, utilization of crude steel capacity dropped to only about 65%; incoming orders continued to decline, and no relief was expected until the end of 1978 at least. Financial losses of the industry, including public and private sectors, were estimated at $90 million in 1977.

The nationalized sector of the steel industry, which had frequently been accused of overstaffing, continued to reduce its work force by a freeze on new hirings and voluntary retirement schemes. Late in December, these measures were supplemented by placing 15,000 workers on shorttime for at

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least 3 months.

Austria had difficulty defending itself against price cuts by foreign steel producers, and imports increased from about 13% of consumption in 1974 to 25% by 1977. In November, the Government announced that it would institute a monitoring system for steel products to provide a tool by which underpriced imports could be controlled in the future through agreements with the European Coal and Steel Community and other supplier governments.

Vöest Alpine Montan AG (VAM), the Government-owned steel company that, with its subsidiaries, produces all Austrian iron ore and steel, began modernizing its managerial structure to provide greater flexibility and accountability to various activities, such as mining, metallurgy, processing, and finishing, by forming them into separate and more responsive divisions.

The year 1977 was the 25th anniversary of the introduction by VAM of the Linz-Donawitz (LD) basic oxygen steelmaking process, an Austrian development that revitalized the Austrian steel industry after World War II and then revolutionized the world industry. At the last LD international working meeting in Linz, before the patents expired, officials credited the LD process with a large part of the success of the Austrian industry in raising annual capacity to almost 5 million tons from less than 1 million tons after the war. In 1977, over 80% of Austrian steel was produced by the LD process.

VAM commissioned its new blast furnace in July, which had a capacity of 5,500 tons of steel per day; however, this represented largely replacement capacity. The bulk of planned investments in the period 1977-81, estimated to be about $1.4 billion, were, in view of market prospects, likewise earmarked for rationalization and modernization measures with little expansion of capacity.

VAM operated two integrated steel plants—one at Linz, with an annual crude steel capacity of about 3.3 million tons, and one at Donawitz, with an annual capacity of about 1.4 million tons. The Linz plant produces largely flat-rolled products; the Donawitz plant's products include billets, rods, and shapes.

Vereinigte Edelstahlwerke AG (VEW), the specialty steels producer formed in 1975, also suffered from weak markets. It was feared that the problem was structural, not cyclical, in that traditional importing countries were increasing their own capacity and carbon steels were taking over some of the market. VEW, which exported almost 80% of its output, suffered a loss of $15 million in 1976 and expected a loss again in 1977. Most of VEW's foreign customers were European countries, not developing nations.

Austria's three iron ore mines were operated by VAM. The largest, Erzberg (northwest of Leoben), contributed, from both open pit and underground, 89% of the total ore produced. There were two smaller mines—Radmer, nearby, and Hüttenberg, near Friesach in Carinthia Province. The Hüttenberg mine was reported to have only about 3 years of production life remaining.

NONMETALS

Cement.—Fifteen cement plants, with a total annual kiln capacity of 6.4 million tons, made up the Austrian industry in 1977. The largest producer was Perlmooser Zementwerke AG, with a total capacity of 2.8 million tons, including the largest Austrian plant at Mannersdorf, near Vienna, with a capacity of 1 million tons.

Salt.—A new salt evaporation plant was being constructed at Steinkogel, near Ebensee, by Österreichische Salinen AG, the nationalized salt producer. The plant will have an annual capacity of 400,000 tons of salt, produced from brines from solution mining, upon its completion in 1979.

Capacity of the Austrian salt industry in 1977 was 2 million cubic meters of brine per year from solution mines near Altaussee (where a small amount of rock salt was also produced), Hallstatt, Bad Ischl, and Hallein (Dürrnberg). Evaporation plants at Ebensee, Hallein, and Bad Aussee had a total capacity of 330,000 tons per year of salt; the mine and plants were located in the Salzkammergut, the region east and south of Salzburg. Austrian demand was about 360,000 tons annually, of which 160,000 tons was for industrial salt, 65,000 tons was for cattle and common salt, 45,000 tons was for edible salt, and 90,000 tons was for salt for road deicing.

MINERAL FUELS

The Austrian Institute for Economic Research forecast a deterioration in Austria's fuel and power situation. In the 15-year period studied, the share of domestic energy in total consumption fell from about two-thirds in the early 1960's to not much more than one-third in 1977. In this period, however, only the contribution of coal decreased

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in absolute terms; oil, gas, and hydroelectric power all grew significantly. The Institute predicted a further decline in domestic energy's share to about one-fifth of total consumption in the late 1980's. It foresaw a continuation of present trends toward greater consumption of oil and gas, modest growth in hydroelectricity and nuclear electricity in spite of the high costs and environmental problems associated with them, and a decline in the relative significance of coal and lignite. Imports of both oil and gas were expected to almost double by 1990.

A revision of Austria's energy plan, projecting the supply-distribution pattern over the next 15 years, was substantially different from earlier versions in that it eliminated the two nuclear facilities that were to follow the one now nearing completion. Power companies revised their plans to emphasize conventional facilities, both thermoelectric and hydroelectric, but were uncertain of their ability to meet the country's future demands without nuclear facilities.

Austrian energy balances for 1975 and 1976 are presented in table 5.

Table 5.—Austria: Supply and apparent consumption of fuels and power

(Million tons of standard coal equivalent[1])

	Total energy	Coal and coke	Petroleum and refinery products	Natural gas	Fuelwood	Hydroelectric power
1975:						
Production	r15.8	1.7	3.0	3.3	0.9	r6.9
Imports	19.4	3.9	12.6	2.5	--	.4
Exports	1.0	--	.2	--	--	.8
Apparent consumption	r [2]34.2	5.6	15.4	5.8	.9	r6.5
1976:						
Production	15.1	1.5	3.0	2.8	.9	[3]6.9
Imports	20.8	4.2	12.7	3.5	--	.4
Exports	.9	--	.2	--	--	.7
Apparent consumption	[2]35.0	5.7	15.5	6.3	.9	6.6

rRevised.
[1]1 ton standard coal equivalent (SCE)=7,000,000 kilocalories.
[2]Includes refinery and other losses and nonfuel uses.
[3]Calculated at 1,000 kilowatt-hours=0.123 tons SCE, which understates the utility of hydroelectric power.

Sources: International Energy Agency, Organization for Economic Cooperation and Development (OECD). Energy Balances of OECD Countries, 1974/1976, Paris. 1978, pp. 17-29.

Coal.—VAM exercised its option to acquire for $33.3 million an 80% interest in three mines in West Virginia's McDowell and Wyoming Counties from A. T. Massey Coal Co. Inc., a subsidiary of St. Joe Minerals Corp., in order to obtain additional metallurgical coal from a secure source. (In 1976, about 85% of Austria's coal imports came from Eastern Europe.) Total annual output from the U.S. mines was expected to approach 750,000 tons, of which VAM would be entitled to 80%.

Austrian officials conferred with Hungarian Government officials about possible joint mining of lignite deposits extending over the border. About 50 million tons are available in Austria and even larger amounts in Hungary. At the conference, it was announced that the firm Graz-Köflacher Eisenbahn und Bergbaugesellschaft (GKB) would shortly start to determine reserves in the most favorable area, around Höll and Eberau in Burgenland Province.

In October, removal of overburden started at a new open pit at GKB's Oberdorf lignite mine. Reserves were put at 33 million tons, and 1 million tons was to be produced annually after 1980. The lignite was to be delivered to a new 308-megawatt powerplant of Österreichische Draukraftwerke AG at Voitsberg, construction of which was also begun in 1977.

Austria was particularly interested in, and stood to profit by, a $200 million slurry coal pipeline that was agreed upon in principle by Poland and Italy. It would run from Katowice, Poland, to Trieste, Italy, and Austria could construct a spur from the Czechoslovak border to Linz for the supply of coal to the VAM steel mill. Other industries along the Danube River could be supplied with dried coal by barge.

Coal mines operating in Austria in 1977, all owned by nationalized concerns, are listed in the following tabulation. The

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Fohnsdorf mine produces glanzkohle, a bright lignitic coal, and the other mines produce braunkohle, a duller lignite.

Company	Mine	Location	Approximate annual capacity (thousand metric tons)
Graz-Köflacher Eisenbahn und Bergbaugesellschaft	Fohnsdorf	Fohnsdorf, Styria	400
	Karlsschacht[1]	Köflach, Styria	1,000
	Oberdorf	Bärnbach, Styria	300
	Zangtal	Voitsberg, Styria	600
Wolfsegg Traunthaler Kohlenwerks AG	Hinterschlagen	Ampfelwang, Upper Austria	600
	Schmitzberg	Do	
Salzach Kohlenbergbau GmbH	Trimmelkam	Trimmelkam, Upper Austria	500

[1]Underground and open pit.

Natural Gas.—In 1977-80, the nationalized Österreichische Mineralölverwaltung AG (OMV) planned to spend $143 million for two major natural gas pipeline projects. One of these, the so-called West Austria Gas Pipeline, with an initial annual capacity of 5 billion cubic meters, was to transport Soviet gas from the Austrian-Czechoslovak border to the West German border for eventual delivery to France. The other projected pipeline, the South East Gas Pipeline, with an initial annual capacity of 800 million cubic meters, would branch off from the existing Transaustria Pipeline and would supply Yugoslavia's northern industrial zone with natural gas, also from the U.S.S.R. Both pipelines would be used to supply Austrian areas along the new transport facilities.

Petroleum.—The State-owned oil company OMV planned to counteract the recent downward trend in Austrian crude oil production by a program of deeper drilling. The country's first 7,000-meter-plus exploration well was started in November with a new, very large, and very powerful rig at Zistersdorf in the Vienna Basin where, coincidentally, Austria's first commercial production was attained before World War II; the well was expected to reach its initial target depth late in 1978.

Production to date has been from Cenozoic (10-million- to 30-million-year-old) and Mesozoic (60-million- to 160-million-year-old) formations, but indications nearby in Czechoslovakia were of possible hydrocarbons in Paleozoic (300-million-year-old) formations at the greater depth that the Zistersdorf well could reach. Previous attempts to penetrate to this depth had been frustrated by an extremely hard flysch layer.

Production in 1977 was about 12.5 million barrels of crude, a decline of about 10% from that of 1976. About 82% was from the Vienna Basin, north and northeast of Vienna, of which 62%, or 51% of the Austrian total was from the Matzen field discovered in 1949. The Molasse zone in Upper Austria Province, south of Wels, yielded the remaining 18% of the production; the most productive field continued to be that at Voitsdorf (32% of Molasse zone output).

After March 1, 1977, Austrian petroleum importers were obliged to keep on hand strategic stocks equal to 5% of the imports of the preceding year. This amount would increase 5% per year, reaching a ceiling of 20% in 1980. A total of 1.3 million tons of storage capacity will be required by 1985. The first storage capacity will be 480,000 tons at Lannach in Styria Province, and an additional capacity of 200,000 tons was planned for western Austria. Private oil firms formed a corporation, Erdöl-Lagergesellschaft mbH, to operate the facilities.

Uranium.—OMV joined the West German firm Pryssok und Co. KG in examination of the uranium occurrence at Forstau, on the border of Salzburg and Styria Provinces. Diamond drilling also continued at Tweng and Mauterndorf, two prospects near Forstau. In all, about 77 persons were employed in the exploration work in the Forstau area.

[1]Supervisory physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Austrian schillings (S)/to U.S. dollars at the average rate of S16.53 = US$1.00.

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The Mineral Industry of Belgium-Luxembourg

By William F. Keyes[1]

BELGIUM

The Belgian economy was stagnant during 1977; unemployment was high, and a number of industries, particularly the steel industry, were seriously depressed. The gross national product (GNP) grew only about 2.5% in real terms, well below Government forecasts, and inflation continued at the rate of 7.1% at the wholesale level. Social costs continued to be high, and domestic and foreign markets continued weak.

Belgium had important steel and petroleum-refining industries and was a significant processor of imported copper, lead, and zinc ores, concentrates, and metals; other metals were obtained as a byproduct of the refining of these metals. The steel industry was being restructured during the year to meet the worsened outlook for its products, the policy of assisting some coal mines and closing others was continued, and the petroleum industry continued to operate at only two-thirds of capacity.

PRODUCTION

The slowdown in the economy and the mineral industry from 1976 to 1977 is illustrated by the decline in production indexes in the period: General industrial production fell from 118 to 117, extractive industries fell from 68 to 65, and steel fell from 96 to 88; only nonferrous metals improved, rising from 130 to an estimated 145. Belgium's position as a mineral processor largely dependent upon imported raw materials was clearly threatened by the rigidity of its mineral economy and the changing nature of the world mineral economy, in which processing capacity was being expanded in producing countries.

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Table 1.—Belgium: Production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity[1]		1975	1976	1977[p]
METALS				
Aluminum metal, secondary only	tons	2,700	2,600	e2,600
Cadmium	do.	972	1,200	1,440
Copper:				
Blister[e]	do.	11,000	6,000	6,000
Refined, including alloys	do.	357,024	481,788	563,280
Iron and steel:				
Ore and concentrate		93	63	47
Metal:				
Pig iron		9,082	9,877	8,906
Ferroalloys		98	84	73
Steel:				
Crude		11,583	12,145	11,256
Semimanufactures		9,151	9,588	e9,300
Lead metal:				
Primary	tons	103,000	109,500	116,900
Secondary	do.	11,948	12,024	5,896
Total	do.	114,948	121,524	122,796
Selenium[e]	kilograms	65,000	60,000	60,000
Tin metal:				
Primary	tons	4,562	4,068	3,520
Secondary	do.	958	1,992	1,484
Total	do.	5,520	6,060	5,004
Zinc:				
Slab zinc:				
Primary	do.	218,264	234,748	247,628
Secondary (remelted zinc)	do.	6,700	6,500	10,600
Total	do.	224,964	241,248	258,228
Zinc powder	do.	46,320	42,420	43,632
Other nonferrous metals:				
Precious metals, unworked, not further specified[2]	thousand troy ounces	30,046	30,637	29,373
Base metals, unspecified[3]	tons	5,484	7,504	7,764
NONMETALS				
Cement, hydraulic		6,884	7,504	7,764
Clays		116	107	109
Fertilizer materials, manufactured:				
Nitrogenous, N content		397	399	584
Phosphatic, gross weight:				
Thomas slag		r1,168	972	841
Superphosphate, ordinary		126	175	178
Other		509	398	468
Gypsum and anhydrite, calcined	tons	221,268	219,708	167,436
Lime and dead-burned dolomite:				
Quicklime		2,520	2,304	2,316
Dead-burned dolomite		234	209	172
Sodium and potassium compounds: Sodium carbonate	tons	367,044	351,456	441,444
Stone, sand and gravel:				
Calcareous:				
Dolomite		2,477	2,658	2,524
Limestone		22,860	24,156	29,076
Marble:				
In blocks	cubic meters	2,328	2,340	3,048
Crushed and other	tons	2,844	4,944	3,132
Petit granite marble (Belgian bluestone):				
Quarried	cubic meters	407,556	739,800	679,656
Sawed	do.	67,824	67,944	68,292
Worked	do.	10,464	9,336	9,612
Crushed and other	do.	537,612	626,916	577,080
Porphyry, all types		5,436	6,289	5,726
Quartz and quartzite	tons	r372,294	311,422	244,580
Sandstone:				
Rough stone, including crushed		2,107	2,267	2,494
Paving and mosaic stone	tons	r407	894	2,844
Other	do.	44,076	4,0773	--
Slate		1,416	NA	NA
Sand and gravel:				
Construction sand		10,248	9,744	9,364
Foundry sand		1,032	1,044	1,039
Dredged sand		860	1,236	1,242
Glass sand		1,608	1,620	1,661
Other sand		2,532	2,244	1,956
Gravel (dredged)		5,916	6,912	7,686
Sulfur, byproduct:				
Elemental		24	35	60
Other forms		172	183	169
Total		196	218	229

See footnotes at end of table.

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Table 1.—Belgium: Production of mineral commodities —Continued

(Thousand metric tons unless otherwise specified)

Commodity[1]		1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS				
Carbon black[e]	tons	2,000	2,000	2,000
Coal:				
Anthracite		1,507	1,126	796
Bituminous		5,972	6,112	6,272
Total		7,479	7,238	7,068
Coke, all types		5,724	6,216	5,568
Fuel briquets, all kinds		264	166	126
Gas:				
Natural	million cubic feet	[r]1,787	1,186	1,009
Manufactured	do.	24,706	35,173	23,551
Petroleum refinery products:				
Gasoline	thousand 42-gallon barrels	39,177	33,448	43,155
Jet fuel	do.	8,320	8,544	14,024
Kerosine	do.	217	302	1,008
Distillate fuel oil	do.	68,528	67,677	86,230
Residual fuel oil	do.	67,393	68,558	84,482
Lubricants	do.	595	707	714
Other	do.	21,682	25,634	26,088
Refinery fuel and losses	do.	8,356	8,195	13,079
Total	do.	214,268	213,065	268,730

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, Belgium produces a number of other metals for which only aggregate output figures are available. These aggregates are listed under "Other nonferrous metals."

[2]Known to include gold and silver and may include platinum-group metals.

[3]Derived by substracting aluminum data from a reported total for unspecified base metals.

TRADE

Belgium was a major processor of mineral raw materials, supplying both its own economy and those of its neighbors with imports from major mining countries, including Canada, Australia, and Ireland. Belgium also had significant trade with the United States; coal, sulfur, phosphate rock, and molybdenum were typical large imports, while exports to the United States included cut diamond, steel semimanufactures, and nonferrous metals. Table 4 gives a summary of Belgian-Luxembourg mineral trade with the United States.

Table 2.—Belgium-Luxembourg: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Bauxite and concentrate	75	55	NA.
Oxide and hydroxide	437	694	West Germany 604.
Ash and residue containing aluminum	4,870	2,039	West Germany 1,615.
Metal including alloys:			
Scrap	18,096	32,127	France 12,386; West Germany 8,720; Netherlands 7,237.
Unwrought	9,972	14,195	West Germany 7,904; Netherlands 3,665.
Semimanufactures	169,848	206,508	France 49,598; West Germany 48,898; Netherlands 22,613.
Antimony:			
Ore and concentrate	31	19	NA.
Metal including alloys, all forms	44	162	Poland 125.
Arsenic, natural sulfides	249	1	NA.
Beryllium metal including alloys, all forms kilograms	200	--	
Cadmium metal including alloys, all forms	917	835	West Germany 305; United States 230; France 191.
Chromium:			
Chromite	208	323	NA.
Oxide, hydroxide, trioxide	33	15	NA.
Metal including alloys, all forms	127	28	NA.

See footnotes at end of table.

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Table 2.—Belgium-Luxembourg: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Copper:			
Ore and concentrate	4,399	772	United Kingdom 317; West Germany 239.
Matte	1,204	1,428	United Kingdom 1,372.
Copper sulfate	7,631	7,648	Netherlands 2,292; Denmark 1,620; West Germany 1,057.
Ash and residue containing copper	7,104	3,233	France 1,673; West Germany 843; Spain 393.
Metal including alloys:			
Scrap	7,855	12,898	West Germany 4,855; Netherlands 2,800; France 2,098; Italy 1,665.
Unwrought	254,688	316,015	France 97,387; West Germany 59,310 Italy 40,109; United Kingdom 34,211.
Semimanufactures	146,004	202,882	France 70,511; West Germany 52,488; Netherlands 33,000.
Germanium metal including alloys, all forms	(1)	(1)	NA.
Gold:			
Waste and sweepings, value, thousands	$535	$253	Netherlands $218.
Metal, unworked or partly worked, thousand troy ounces	475	193	United Kingdom 78; West Germany 53; Netherlands 23.
Iron and steel:			
Ore and concentrate, except roasted pyrite, thousand tons	71	20	France 16.
Roasted pyrite, do.	155	178	West Germany 170.
Metal:			
Scrap, do.	531	527	West Germany 205; France 139.
Pig iron, including cast iron, do.	11	34	West Germany 17; France 11.
Sponge iron, powder, shot, do.	1	1	Mainly to West Germany and Spain.
Spiegeleisen	859	351	West Germany 187; France 139.
Ferroalloys:			
Ferromanganese, thousand tons	43	70	United States 27; France 20; West Germany 12.
Other, do.	15	26	France 9; West Germany 1; Italy 1.
Steel, primary forms, do.	2,400	2,280	France 1,065; West Germany 382.
Semimanufactures:			
Bars, rods, angles, shapes, sections, do.	4,526	4,408	West Germany 1,372; France 884; Netherlands 516.
Universals, plates, sheets, do.	3,691	3,780	France 1,186; West Germany 1,036.
Hoop and strip, do.	594	669	West Germany 250; France 217.
Rails and accessories, do.	95	64	France 15; Iran 14; Italy 11.
Wire, do.	342	436	West Germany 98; United States 57; France 56.
Tubes, pipes, fittings, do.	240	283	West Germany 82; Netherlands 52; France 42.
Castings and forgings, rough, do.	39	45	West Germany 9; Netherlands 9; France 5.
Lead:			
Ore and concentrate	2	7	NA.
Oxides	4,919	8,663	Netherlands 5,030; West Germany 2,238.
Ash and residue containing lead	8,322	14,168	Netherlands 11,461; West Germany 2,359.
Metal including alloys:			
Scrap	6,642	8,328	France 3,468; Netherlands 2,930; West Germany 1,741.
Unwrought	60,490	73,210	Netherlands 19,670; France 17,550; West Germany 12,415; U.S.S.R. 8,950.
Semimanufactures	4,368	4,970	Netherlands 2,899.
Magnesium metal including alloys:			
Scrap	305	445	Netherlands 193; United States 114.
Unwrought and semimanufactures	r181	196	West Germany 40.
Manganese:			
Ore and concentrate	8,786	9,507	United Kingdom 3,479; Italy 1,326.
Metal	73	30	NA.
Mercury, 76-pound flasks	1,682	986	NA.
Molybdenum:			
Ore and concentrate	3,964	6,542	West Germany 3,478; Italy 884; Japan 846.
Metal including alloys, all forms	123	49	Netherlands 31; France 5.
Nickel:			
Matte, speiss, similar materials	10	--	
Metal including alloys:			
Scrap	1,037	1,603	West Germany 700; United Kingdom 365; France 200.
Unwrought	443	251	West Germany 86; Poland 67; Egypt 32.
Semimanufactures	2,091	2,486	France 14.
Platinum-group metals including alloys, all forms, thousand troy ounces	843	91	West Germany 45; France 16; Netherlands 13.
Selenium, elemental, kilograms	39,800	72,100	West Germany 33,300; United States 15,300.
Silver metal including alloys, thousand troy ounces	25,367	24,609	United Kingdom 9,088; West Germany 6,043; Italy 3,485.
Tin:			
Ore and concentrate	632	11	All to Spain.
Oxides	97	1	NA.
Metal including alloys:			
Scrap	110	51	West Germany 27; France 14; Netherlands 6.
Unwrought	1,907	3,333	France 1,212; West Germany 932; Netherlands 520.
Semimanufactures	118	136	West Germany 46; France 21.

See footnotes at end of table.

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Table 2.—Belgium-Luxembourg: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Titanium:			
Ore and concentrate	5	21	All to West Germany.
Oxides	21,232	30,524	West Germany 11,829; United States 3,051.
Metal including alloys, all forms	11	54	France 17; Netherlands 8.
Tungsten:			
Ore and concentrate	84	86	United Kingdom 80.
Metal including alloys, all forms	123	116	Netherlands 67; West Germany 33.
Uranium and titanium ores and concentrates	234	544	France 531.
Vanadium oxides kilograms	141,800	14,600	NA.
Zinc:			
Ore and concentrate	22,669	28,200	France 11,839; Netherlands 8,842.
Oxides	5,117	6,433	West Germany 1,350; Netherlands 1,248; France 785.
Ash and residue containing zinc	39,845	40,022	West Germany 9,929; France 6,450.
Metal including alloys:			
Scrap	4,734	7,075	France 5,302.
Blue powder (dust)	20,894	25,075	West Germany 10,855; Netherlands 5,968; France 3,233.
Unwrought	180,211	188,043	West Germany 70,711; France 36,363; United States 22,138.
Semimanufactures	5,449	6,308	West Germany 2,284; Netherlands 1,818.
Other:			
Ores and concentrates:			
Of niobium, tantalum, vanadium, zirconium	242	64	NA.
Of precious metals	1	637	NA.
Of base metals, n.e.s	265	3	NA.
Ash and residue containing nonferrous metals, n.e.s	34,800	30,644	Netherlands 19,981; West Germany 5,412.
Waste and sweepings of precious metals value, thousands	$3,713	$2,029	United Kingdom $1,141; West Germany $568.
Oxides, hydroxides, and pentoxides of metals, n.e.s	1,025	1,340	West Germany 412; United States 275; France 198.
Metals including alloys, all forms:			
Metalloids:			
Tellurium and arsenic	10	20	West Germany 15; France 3.
Other	134	102	United Kingdom 18.
Alkali, alkaline-earth, rare-earth metals	101	3	NA.
Pyrophoric alloys kilograms	800	--	--
Base metals including alloys, all forms, n.e.s	172	10	United Kingdom 6; France 2; West Germany 2.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	27,228	65,278	West Germany 64,725.
Dust and powder of precious and semiprecious stones, natural and manufactured kilograms	747	1,125	United States 240; Poland 154; Israel 150.
Grinding and polishing wheels and stones	3,342	2,688	France 1,434; West Germany 434.
Asbestos	1,821	269	France 120; Netherlands 67.
Barite and witherite	434	199	NA.
Boron materials:			
Crude natural borates	4,159	7,703	Netherlands 3,167; France 2,505; West Germany 1,252.
Oxide and acid	171	45	NA.
Bromine kilograms	24,400	1,200	NA.
Cement thousand tons	1,232	1,573	Netherlands 1,109.
Chalk	53,152	68,855	Netherlands 20,258; Kuwait 8,976.
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite	3,551	8,067	France 6,948.
Kaolin	3,655	9,220	Netherlands 5,197; Republic of South Africa 80.
Other	37,426	2,583	France 652.
Products:			
Refractory (including nonclay brick)	41,064	54,186	France 20,521; West Germany 11,380.
Nonrefractory value, thousands	$14,804	$30,779	Netherlands $10,036; West Germany $9,111; France $7,240.
Cryolite and chiolite	987	93	NA.

See footnotes at end of table.

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Table 2.—Belgium-Luxembourg: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Diamond:			
Gem:			
Unworked thousand carats	8,459	15,330	United Kingdom 6,260; India 6,159.
Worked do	2,256	2,627	United States 828; West Germany 331; Hong Kong 285.
Industrial:			
Unworked do	5,871	8,794	United States 1,989; United Kingdom 1,789; Ireland 1,725.
Worked do	27	23	United Kingdom 12; Switzerland 3; West Germany 2.
Diatomite and other infusorial earth	8,162	6,829	Netherlands 6,084.
Feldspar, leucite, nepheline, nepheline syenite	8,867	6,744	Netherlands 6,653.
Fertilizer materials:			
Crude:			
Nitrogenous	1,141	4,863	Italy 2,433; France 1,135; West Germany 759.
Phosphatic	27,996	9,104	France 4,372; West Germany 3,204; Netherlands 1,098.
Potassic (K_2O content)	9,030	10,052	NA.
Manufactured:			
Nitrogenous (N_2 content) thousand tons	288	420	West Germany 116; France 103.
Phosphatic (P_2O_5 content) do	309	248	West Germany 108; France 77.
Potassic (K_2O content) do	223	247	France 63; Norway 35; Netherlands 28.
Other, including mixed do	13	1,294	France 737; West Germany 155.
Ammonia do	190	134	France 116.
Fluorspar	343	840	NA.
Graphite, natural	250	508	NA.
Gypsum and plaster	47,389	78,106	Netherlands 55,467; West Germany 10,107.
Lime thousand tons	691	592	Netherlands 487.
Magnesite	1,859	3,947	France 2,794.
Mica:			
Crude, including splittings and waste	108	376	NA.
Worked, including agglomerated splittings	1,419	1,443	United States 426; West Germany 233; United Kingdom 227.
Pigments, mineral, including processed iron oxides	4,669	4,878	France 3,231; Italy 942.
Precious and semiprecious stones:			
Natural (except diamond):			
Unworked kilograms	665	117	India 60.
Worked:			
Gem do	2,020	494	West Germany 202; United States 98.
Industrial do	(1)	(1)	NA.
Manufactured[2] do	201	3,064	Netherlands 1,638; Japan 900.
Pyrite, gross weight	312	57	NA.
Salt and brine	103,992	106,011	France 88,852; Netherlands 12,084.
Sodium and potassium compounds thousand tons	214	268	NA.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous do	871	821	Netherlands 799.
Slate do	4	3	West Germany 2.
Other do	37	42	NA.
Worked:			
Slate do	1	1	NA.
Paving and flagstone do	13	18	Netherlands 16; West Germany 2.
Other do	9	9	France 2; West Germany 2; Netherlands 2.
Dolomite, chiefly refractory grade do	1,618	1,578	Netherlands 703; West Germany 556; France 290.
Gravel and crushed rock do	9,495	10,181	Netherlands 4,832; France 4,686.
Limestone (except dimension) do	665	646	Netherlands 402; France 226.
Quartz and quartzite do	15	12	West Germany 8.
Sand, excluding metal bearing do	3,161	3,692	France 1,002; Netherlands 957; Italy 375.
Sulfur:			
Elemental, all forms	17,473	36,633	West Germany 17,379; Netherlands 12,478.
Sulfur dioxide	21	38	NA.
Sulfuric acid	106,320	74,115	France 55,440.
Talc, steatite, soapstone, pyrophyllite	15,656	21,533	West Germany 6,864; Sweden 4,164; United Kingdom 3,296.
Other:			
Crude:			
Meerschaum, amber, jet	336	90	NA.
Lithium minerals	3,685	1,390	NA.
Vermiculite, perlite, chlorite	117	46	NA.
Slag, dross, and similar waste, not metal bearing thousand tons	2,903	2,546	France 941; West Germany 808.
Oxides and hydroxides of magnesium, strontium, barium	1,805	678	NA.
Halogens, n.e.s	10	222	NA.

See footnotes at end of table.

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Table 2.—Belgium-Luxembourg: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	5,860	8,092	Netherlands 5,083.
Carbon black and gas carbon:			
Carbon black	11,841	978	France 431; Netherlands 215; West Germany 124.
Gas carbon	31	34	NA.
Coal and briquets:			
Anthracite and bituminous coal thousand tons	542	378	West Germany 258; Netherlands 44.
Briquets of anthracite and bituminous coal do	20	13	France 7; Switzerland 3.
Coke and semicoke do	360	317	United States 102; France 65; West Germany 58.
Gas, natural million cubic feet	r424	360	Mainly to Netherlands.
Hydrogen, argon, other rare gases	13,258	17,220	France 7,252; West Germany 5,656.
Peat, including briquets and litter	859	751	NA.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	571	9	NA.
Refinery products:[3]			
Gasoline do	25,336	13,409	West Germany 3,849; Denmark 1,861; Netherlands 1,757.
Kerosine do	5,715	4,740	West Germany 1,937; Denmark 770.
Distillate fuel oil do	20,711	36,468	West Germany 13,425; Denmark 4,691.
Residual fuel oil do	31,377	35,924	United Kingdom 7,313.
Lubricants do	2,039	2,091	Netherlands 713; West Germany 246.
Other:			
Liquefied petroleum gas do	1,707	1,868	Netherlands 882; United States 499.
White spirit do	1,269	792	West Germany 352; Netherlands 139.
Mineral jelly and wax do	13	30	United Kingdom 8; France 5; Spain 4.
Nonlubricating oils, n.e.s do	7,079	5,674	Netherlands 1,993; West Germany 1,382.
Bitumen and other residues do	1,800	1,303	Netherlands 545; West Germany 321; United Kingdom 164.
Bituminous mixtures, n.e.s do	75	133	Netherlands 97; France 24.
Pitch, pitch coke, petroleum coke do	31	215	Netherlands 193.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals thousand tons	211	252	Netherlands 103; France 42; West Germany 39.

rRevised. NA Not available.
[1]Less than 1/2 unit.
[2]May include diamond.
[3]Includes bunkers.

Table 3.—Belgium-Luxembourg: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite and concentrate	16,380	19,680	Guyana 9,061; Denmark 6,022; West Germany 2,168.
Oxide and hydroxide	12,689	21,057	West Germany 14,629; France 2,931.
Ash and residue containing aluminum	758	1,336	West Germany 1,182.
Metal including alloys:			
Scrap	14,778	19,073	West Germany 6,414; France 5,102; Netherlands 4,449.
Unwrought	188,176	258,248	Netherlands 106,826; Norway 42,403; West Germany 39,507; France 33,200.
Semimanufactures	52,140	79,670	West Germany 37,270; Netherlands 19,956; France 9,773.
Antimony:			
Ore and concentrate	8,707	11,170	Bolivia 4,658; Guatemala 1,382.
Metal including alloys, all forms	222	210	NA.
Arsenic:			
Natural sulfides	53	1	NA.
Trioxides, pentoxides, and acids	121	44	NA.
Beryllium metal including alloys, all forms kilograms	300	100	NA.
Cadmium metal including alloys, all forms	978	1,376	Japan 415; West Germany 248; Zaire 158.
Chromium:			
Chromite	3,714	2,776	Republic of South Africa 1,353; Netherlands 629; Mozambique 231.
Oxide and hydroxide	555	2,120	Japan 1,349; West Germany 382.
Metal including alloys, all forms	232	145	West Germany 71; United Kingdom 56.

See footnotes at end of table.

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Table 3.—Belgium-Luxembourg: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Cobalt oxides and hydroxides ____ kilograms	20,600	65,500	West Germany 37,500; Netherlands 18,000.
Copper:			
Ore and concentrate	46,651	24,053	Chile 10,463; Australia 3,975; Morocco 3,047; Bolivia 2,592.
Matte	214,471	229,932	Zaire 141,227; Republic of South Africa 43,958.
Copper sulfate	1,084	2,257	U.S.S.R. 1,048; France 757.
Ash and residue containing copper	38,970	21,806	Chile 10,463; France 5,480; United States 5,018.
Metal including alloys:			
Scrap	58,545	82,098	France 35,383; Netherlands 14,566; United States 8,942.
Unwrought	190,656	307,789	Zaire 192,096.
Semimanufactures	25,768	36,643	West Germany 17,161; France 6,317; Netherlands 4,221.
Gold:			
Waste and sweepings ___ value, thousands	$610	$2,514	United States $2,100.
Metal, worked and partly worked thousand troy ounces	2,623	1,411	West Germany 1,292.
Iron and steel:			
Ore and concentrate, except roasted pyrite thousand tons	25,520	25,593	France 11,896; Sweden 4,129.
Roasted pyrite ____ do	214	233	France 115; West Germany 77; Sweden 25.
Metal:			
Scrap ____ do	706	586	France 226; Netherlands 139; West Germany 120.
Pig iron, including cast iron ____ do	161	203	West Germany 80; France 56; Brazil 44.
Sponge iron, powder, shot ____ do	6	6	France 2; West Germany 2.
Spiegeleisen ____ do	(1)	(1)	NA.
Ferroalloys ____ do	153	197	Norway 55; France 49; West Germany 28.
Steel, primary forms ____ do	810	1,143	Netherlands 297; West Germany 264; East Germany 137; France 128.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	734	926	France 332; West Germany 167.
Universals, plates, sheets ____ do	520	781	Japan 172; West Germany 127; Netherlands 111; Spain 86.
Hoop and strip ____ do	100	114	France 61; West Germany 35.
Rails and accessories ____ do	11	31	France 27.
Wire ____ do	40	57	West Germany 24; France 15; Netherlands 6.
Tubes, pipes, fittings ____ do	192	163	West Germany 50; France 38; Netherlands 35.
Castings and forgings, rough ____ do	22	35	France 16; West Germany 6; Netherlands 3.
Lead:			
Ore and concentrate	90,268	132,588	Peru 48,558; Canada 18,511.
Ash and residue containing lead	63,015	61,217	France 15,655; West Germany 13,810; United States 12,529.
Oxides	843	1,959	France 923; West Germany 830.
Metal including alloys:			
Scrap	12,439	9,619	West Germany 4,837; Netherlands 3,791.
Unwrought	13,857	33,382	France 14,600; Australia 9,464; United Kingdom 4,389.
Semimanufactures	2,074	1,546	Netherlands 707; West Germany 444; France 158.
Magnesium metal including alloys:			
Scrap	153	209	Netherlands 73; West Germany 59.
Unwrought	1,207	1,232	Italy 394; Norway 252; France 247; U.S.S.R. 158.
Semimanufactures	183	131	United States 29; France 28.
Manganese:			
Ore and concentrate	313,264	328,968	Republic of South Africa 140,392; Ghana 56,777.
Oxides	1,275	1,634	Japan 1,349.
Metal	615	572	Republic of South Africa 235; West Germany 71.
Mercury ____ 76-pound flasks	8,963	2,009	United Kingdom 870; Netherlands 290.
Molybdenum:			
Ore and concentrate	13,175	11,909	Canada 4,174; United States 3,714; Chile 2,450.
Metal including alloys, all forms	77	110	Netherlands 61; France 20.
Nickel:			
Matte, speiss, similar materials	87	83	United Kingdom 38; Australia 18; Canada 11.
Metal including alloys:			
Scrap	1,060	1,172	France 330; United Kingdom 246; Netherlands 146.
Unwrought	3,495	3,439	United Kingdom 611; Cuba 573; Canada 467; France 446; Republic of South Africa 408.
Semimanufactures	3,316	4,802	West Germany 2,540; France 1,229.

See footnotes at end of table.

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Table 3.—Belgium-Luxembourg: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Platinum-group metals including alloys, all forms, troy ounces	292,539	7,365,629	United States 6,812,669.
Selenium, elemental, kilograms	42,300	21,500	Netherlands 5,700; West Germany 4,600; Japan 2,000.
Silver metal including alloys, thousand troy ounces	18,711	21,190	Netherlands 8,914; United States 5,272.
Tin:			
Ore and concentrate	7,210	5,173	Zaire 3,764; Rwanda 1,221.
Oxides	40	35	West Germany 28; Italy 6.
Metal including alloys:			
Scrap	113	214	Netherlands 151.
Unwrought	1,756	2,507	Malaysia 852; Zaire 704; Netherlands 365; United Kingdom 279.
Semimanufactures	300	240	Netherlands 112; West Germany 79; France 29.
Titanium:			
Ore and concentrate	31,350	101,941	Canada 100,999.
Oxides	10,522	11,726	West Germany 4,618; Netherlands 2,951; France 1,451; United States 1,257.
Metal including alloys, all forms	1,598	1,659	United States 1,375.
Tungsten:			
Ore and concentrate	375	454	West Germany 143; Netherlands 86; Zaire 83; People's Republic of China 46.
Metal including alloys, all forms	157	165	Netherlands 85; France 26; United Kingdom 23.
Uranium metal including alloys, all forms, value, thousands	$50,267	$77,004	United Kingdom $76,114.
Zinc:			
Ore and concentrate	610,984	549,982	Canada 349,877.
Oxide and peroxide	7,548	9,217	France 2,696; United Kingdom 2,299; Netherlands 2,021.
Ash and residue containing zinc	71,610	62,736	France 21,546; West Germany 20,410; United States 6,777.
Metal including alloys:			
Scrap	14,330	8,316	France 2,466; Netherlands 1,986; United States 1,342; West Germany 1,168.
Blue powder	784	862	West Germany 409; Italy 152; Netherlands 141; France 97.
Unwrought	23,885	29,051	Netherlands 8,031; North Korea 3,556.
Semimanufactures	9,167	9,863	France 8,636.
Other:			
Ores and concentrates:			
Of niobium, tantalum, vanadium, zirconium	1,002	1,710	Canada 671; Netherlands 278; United States 246.
Of precious metals	241	574	Bolivia 447; Colombia 127.
Of base metals, n.e.s	475	646	Netherlands 354.
Ash and residue containing nonferrous metals, n.e.s	33,993	42,004	West Germany 28,831; Republic of South Africa 4,634.
Waste and sweepings of precious metals, value, thousands	$17,209	$9,587	United States $4,226; France $2,446; Netherlands $1,820.
Oxides, hydroxides, peroxides of metals, n.e.s	1,936	2,014	West Germany 842; Republic of South Africa 295; France 223.
Metals including alloys, all forms:			
Metalloids:			
Tellurium and arsenic	69	77	Sweden 45; U.S.S.R. 14.
Other	440	434	France 166; West Germany 108; United States 75.
Alkali, alkaline-earth, rare-earth metals	49	150	U.S.S.R. 50; West Germany 35; Brazil 28; France 20.
Pyrophoric alloys	3	3	NA.
Base metals including alloys, all forms, n.e.s	75	159	United States 54.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	90,427	77,335	West Germany 76,392.
Dust and powder of precious and semiprecious stones, natural and manufactured, including diamond, kilograms	1,974	3,016	Ireland 1,485; United States 1,141.
Grinding and polishing wheels and stones	2,533	2,506	West Germany 733; Netherlands 386; France 260.
Asbestos	60,549	70,370	Canada 32,351; U.S.S.R. 19,626; Republic of South Africa 9,383.
Barite and witherite	7,829	8,477	France 5,170; West Germany 2,975.
Boron materials:			
Crude material borates	49,838	60,637	Netherlands 36,725; Turkey 22,155.
Oxide and acid	1,495	1,952	France 1,448.
Bromine, kilograms	46,100	26,800	NA.
Cement	76,328	96,656	Netherlands 61,513; France 11,241.

See footnotes at end of table.

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Table 3.—Belgium-Luxembourg: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Clays and clay products:			
Crude:			
Bentonite	22,654	27,822	West Germany 10,516; Netherlands 6,996; United States 6,187.
Kaolin	237,206	252,834	United Kingdom 87,739; Netherlands 56,612; West Germany 28,907.
Other	198,853	226,611	West Germany 131,021; France 34,779; Netherlands 29,875.
Products:			
Refractory (including nonclay brick)	108,054	97,228	West Germany 50,197.
Nonrefractory value, thousands	$75,742	$89,457	West Germany $28,379; Italy $23,140; Netherlands $17,328.
Cryolite and chiolite	112	114	NA.
Diamond (except powder):			
Gem:			
Unworked thousand carats	12,535	19,753	United Kingdom 16,825.
Worked do	1,279	1,692	India 519; Israel 253; U.S.S.R. 245.
Industrial:			
Unworked do	7,772	9,384	Ireland 3,500; United States 1,727; United Kingdom 1,394; Canada 1,183.
Worked do	7	9	United Kingdom 5; West Germany 1.
Diatomite and other infusorial earth	7,403	6,341	France 2,564; Denmark 2,025.
Feldspar, leucite, nepheline, nepheline syenite	61,532	66,232	Norway 38,517; France 19,333.
Fertilizer materials:			
Crude:			
Nitrogenous	12,464	18,726	Chile 17,404.
Phosphatic thousand tons	1,771	1,582	Morocco 1,088.
Potassic	1,286,227	9,831	West Germany 5,564; France 4,267.
Manufactured:			
Nitrogenous (N_2 content)	10,213,191	148,365	France 29,670; West Germany 29,580; Netherlands 26,261.
Phosphatic (P_2O_5 content)	1,320,278	36,071	United States 8,171; Tunisia 5,304; Netherlands 4,085.
Potassic	53,255,196	486,528	West Germany 167,955; France 158,477; U.S.S.R. 101,944.
Other, including mixed	122,643	215,418	France 49,639; United States 46,715; West Germany 24,987.
Ammonia	1,499	2,043	West Germany 1,237; Netherlands 490.
Fluorspar	10,101	16,203	France 6,927; People's Republic of China 5,013; West Germany 2,909.
Graphite, natural	1,915	1,068	West Germany 346; Madagascar 300; United Kingdom 118.
Gypsum and plasters	470,371	473,300	France 446,010.
Lime	107,573	212,965	France 139,864; West Germany 66,355.
Magnesite	25,940	28,310	Greece 14,755; Czechoslovakia 3,398; Netherlands 3,307.
Mica:			
Crude, including splittings and waste	7,034	2,034	India 476; United Kingdom 426; France 423; Madagascar 255.
Worked, including agglomerated splittings	38	62	West Germany 32; Switzerland 15.
Pigments, mineral, including processed iron oxides	6,104	7,706	West Germany 6,255.
Precious and semiprecious stones, except diamond:			
Natural:			
Unworked kilograms	9,543	6,521	West Germany 3,638; Zambia 1,370.
Worked:			
Gem do	1,449	1,687	West Germany 746; Netherlands 150.
Industrial do	42	11	NA.
Manufactured do	3,816	2,123	United States 697.
Pyrite, gross weight	207,810	220,452	Spain 220,272.
Salt and brine thousand tons	796	935	Netherlands 481; West Germany 426.
Sodium and potassium compounds, n.e.s	44,605	25,833	West Germany 11,321; United Kingdom 9,018.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	155,295	169,113	France 43,829; West Germany 40,167.
Worked	67,655	73,745	Italy 22,655; France 18,037; West Germany 8,177.
Dolomite, chiefly refractory grade	74,991	93,571	West Germany 62,444; France 24,070.
Gravel and crushed rock thousand tons	5,249	5,768	Netherlands 2,704; United Kingdom 1,315; West Germany 970.
Limestone (except dimension)	281,893	307,420	United Kingdom 206,646; France 12,459.
Quartz and quartzite	115,822	110,630	West Germany 18,512; Norway 12,459.
Sand, excluding metal bearing thousand tons	8,959	11,139	Netherlands 9,996.
Sulfur:			
Elemental, all forms	441,676	461,510	United States 349,655.
Sulfur dioxide	4,182	6,708	West Germany 6,166.
Sulfuric acid	162,263	178,792	West Germany 82,401; France 42,304; Netherlands 30,946.
Talc, steatite, soapstone, pyrophyllite	23,403	39,026	United States 18,791; Australia 6,751; France 4,025.

See footnotes at end of table.

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Table 3.—Belgium-Luxembourg: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Other:			
Crude:			
Lithium minerals	4,586	1,310	Republic of South Africa 983; Netherlands 314.
Vermiculite, perlite, chlorite	55,903	45,780	U.S.S.R. 19,388; Turkey 12,860; Greece 9,482.
Other	166,368	209,731	Spain 88,844; Netherlands 82,265.
Slag, dross, and similar waste, not metal bearing	468,751	731,659	France 605,908.
Oxides and hydroxides of magnesium, strontium, barium	1,023	1,411	West Germany 468; U.S.S.R. 225; United Kingdom 156.
Halogens (other than chlorine and bromine)	21	137	Chile 75; Japan 44.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	66,155	79,353	France 70,751.
Carbon black and gas carbon:			
Carbon black	25,478	30,869	West Germany 12,064; Netherlands 9,940; France 3,524.
Gas carbon	2,311	2,346	West Germany 2,189.
Coal and briquets:			
Anthracite and bituminous coal thousand tons	6,793	7,842	West Germany 3,747; United States 2,125.
Briquets of anthracite and bituminous coal do.	162	101	West Germany 92.
Lignite and lignite briquets do.	62	57	West Germany 56.
Coke and semicoke do.	3,022	2,719	West Germany 2,206.
Gas, natural million cubic feet	629,044	424,964	Netherlands 422,862.
Hydrogen, argon, rare gases	5,112	7,766	Netherlands 4,918; France 1,469.
Peat, including peat briquets and litter	115,535	140,215	West Germany 73,663; Netherlands 65,870.
Petroleum:			
Crude and partly refined:			
Crude thousand 42-gallon barrels	r191,802	211,197	Saudi Arabia 110,488; Iran 36,910.
Partly refined do.	r10,674	7,013	Algeria 854; Spain 795; U.S.S.R. 787.
Refinery products:			
Gasoline do.	6,006	7,711	Netherlands 6,043.
Kerosine do.	563	734	Venezuela 240; Netherlands 208; Trinidad and Tobago 195.
Distillate fuel oil do.	23,492	28,030	Netherlands 16,802; U.S.S.R. 3,558.
Residual fuel oil do.	14,272	21,692	Netherlands 15,012.
Lubricating oil and grease do.	2,877	2,616	Netherlands 853; France 627; West Germany 338.
Other:			
Liquefied petroleum gas do.	4,895	19,475	Netherlands 18,315.
White spirit do.	110	197	United Kingdom 68; Netherlands 60; France 40.
Mineral jelly and wax do.	94	136	West Germany 61; France 28; United Kingdom 18.
Nonlubricating oil, n.e.s do.	1,984	2,060	Netherlands 1,971.
Bitumen and other residues do.	909	511	Netherlands 262; France 207.
Bituminous mixtures, n.e.s do.	145	174	Netherlands 87; France 48; West Germany 19.
Pitch, pitch coke, petroleum coke do.	787	448	United States 356; West Germany 47.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	112,799	96,303	Netherlands 37,137; West Germany 18,733; France 12,975.

NA Not available.
[1]Less than 1/2 unit.

Table 4.—Belgium-Luxembourg: Mineral trade with the United States, 1976[1]

Commodity	Exports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
METALS				
Aluminum metal including alloys	20,808	$26,992	1,034	$1,877
Copper:				
Ore, concentrate, matte	--	--	14,027	5,493
Metal including alloys	5,410	7,962	3,476	6,786
Iron and steel:				
Ore and concentrate	--	--	106	1
Metal:				
Scrap	NA	25	6,353	3,789
Pig iron	NA	1	--	--
Ferroalloys	30,060	9,834	130	911
Steel, primary forms	1,469	518	180	35

See footnotes at end of table.

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Table 4.—Belgium-Luxembourg: Mineral trade with the United States, 1976[1] —Continued

Commodity	Exports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
METALS —Continued				
Iron and steel —Continued				
Metal —Continued				
Semimanufactures:				
Bars and angles	176,155	$47,073	30,202	$7,147
Plates and sheets	151,626	40,053	63,428	16,359
Hoop and strip	5,447	2,603	60	141
Rails	4,447	1,245	--	--
Wire	49,921	33,883	167	365
Tubes and pipes	10,139	3,023	1,160	3,432
Castings and forgings	158	376	2,557	2,406
Lead:				
Ore and concentrate	NA	(2)	--	--
Metal including alloys	255	130	648	172
Lead-zinc ores and concentrates	--	--	56,572	13,661
Molybdenum metal including alloys	--	--	3,117	21,210
Nickel metal including alloys	48	264	292	3,135
Platinum-group metals and silver:				
Ores	4	5,411	1,260	8,960
Metals:				
Platinum-group	NA	318	NA	787
Silver metal including alloys	--	--	82	766
Radioactive and associated materials	3	462	197	4,543
Tin metal including alloys	50	(2)	4	46
Zinc metal including alloys	30,175	23,736	1,189	2,554
Other nonferrous metals:				
Ores and concentrates, n.e.s	17	59	2,745	157
Base metals including alloys, n.e.s	1,872	16,580	1,510	7,851
Scrap	951	1,781	26,644	15,165
NONMETALS				
Abrasives, natural, including diamond	97	820	3,227	4,080
Asbestos, all forms	--	--	NA	211
Cement	13,066	751	1,075	168
Clays and refractory materials	--	--	6,390	703
Diamond and precious stones:				
Industrial diamond	8	2,753	608,211	203
Gem diamond and precious stones	13	232,034	4	26,138
Fertilizer materials:				
Crude, phosphatic	--	--	784,922	27,795
Manufactured, potash	11,787	1,065	4,535	247
Ammonia, anhydrous	--	--	14,515	993
Oxygen, nitrogen, rare gases	--	--	3,905	2,866
Salt, sodium chloride	9	18	--	--
Stone, sand and gravel:				
Dimension stone	189	109	--	--
Crushed and broken stone, sand and gravel	314	12	821	248
Sulfur:				
Sulfur and unroasted pyrites	--	--	608,222	30,020
Sulfuric acid	--	--	16	1
Other, crude	4,696	3,890	19,110	1,170
MINERAL FUELS AND RELATED MATERIALS				
Asphalt, natural	--	--	606	123
Coal, all types	--	--	1,997,062	91,763
Coke	101,727	5,172	48,763	1,843
Petroleum:				
Crude and partly refined	16,349	1,117	--	--
Refinery products:				
Gasoline	7	2	--	--
Residual fuel oil	170,866	11,883	--	--
Lubricants	3	5	94,781	19,432
Petroleum jelly and mineral waxes	--	--	325	377
Petroleum coke, asphalt, etc	40,591	4,169	650,653	27,836
Total	XX	486,129	XX	363,966

NA Not available. XX Not applicable.
[1]Data may differ from those reported elsewhere in this chapter owing to a difference in source.
[2]Less than 1/2 unit.

Source: U.S. Department of Commerce, Bureau of the Census.

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COMMODITY REVIEW

Metals.—*Aluminum.*—Belgium produced no primary aluminum. Large quantities of ingot were imported from other members of the European Economic Community (EEC), especially the Netherlands, and Belgium together with the Federal Republic of Germany were the largest exporters of semimanufactured aluminum in the EEC. About 80% of aluminum semimanufactures is exported, of which two-thirds goes to other members of the EEC.

Output of rolled aluminum products increased significantly in 1977 as a result of the 1976 startup by Soc. Industrielle de l'Aluminium S.A. (SIDAL) of a new rolling mill at Duffel, south of Antwerp.

Lead-Zinc.—Métallurgie Hoboken-Overpelt S.A., Belgium's major copper-lead-zinc producer, again cut production at midyear to 65% of capacity at its electrolytic zinc plant at Overpelt, east of Antwerp, which has one-third of total domestic capacity. It was feared that additional cuts would be necessary.

Other electrolytic zinc producers were Soc. des Mines et Fonderies de Zinc de la Vieille-Montagne (with about one-half of Belgian capacity at Balen) and Soc. de Prayon S.A. (near Liège).

Iron and Steel.—The steel industry continued to be in trouble throughout Western Europe during the year, but Belgium suffered particularly from outmoded facilities, high costs, overstaffing, and heavy dependence on sluggish export markets. The industry continued to be kept alive by Government financing and guarantees, while company decisions were held in abeyance until the result of new studies became known.

In March, a conference representing Government, steel company, and financial interests established a moratorium suspending investment in new capacity, layoffs, stock transfers, and credit changes. The Government then guaranteed the existing private credit lines, amounting to 30 billion Belgian francs (BF), and granted a further BF10 billion credit to industry members. As a final measure, the U.S. consulting firm McKinsey and Co. was engaged to study the steel industries of Belgium and Luxembourg and to recommend long term measures for improvement.

The individual companies of the steel industry reported heavy losses. The specialty steels producer Forges et Laminoirs de Jemappes was to be liquidated in May but was saved by the Cockerill Group's agreement to set up a successor company, Laminoirs de Jemappes, with BF25 million of Cockerill's capital and BF125 million of Government equity, the first participation ever by the Government in the steel industry. An additional BF100 million would be available as a loan from the Government firm Soc. Nationale de Credit a l'Industrie, and BF140 million would be available as a direct State loan. Jemappes' new strip mill would continue in operation, but the two open-hearth furnaces would be shut down, leaving raw steel capacity at 35,000 tons per year in two 25-ton arc furnaces. Cockerill itself suffered deficits of almost BF4 billion in 1975 and almost BF2 billion in 1976 and expected to lose about BF8 billion in 1977 despite vigorous cost cutting. The Belgian-Luxembourg steel company Métallurgique et Minière de Rodange-Athus S.A. (MMRA) was the object of an emergency salvage operation. (See "Luxembourg.")

The McKinsey report was not released by yearend, but certain details were available. The industry was seen as suffering from outmoded plants, relatively high energy and labor costs, and overreliance on the sale of basic, low-profit products rather than specialty steels, and as only a marginal supplier in export markets. Major cost reductions were needed if the industry was to continue to exist.

In October, the Belgian Minister of Economic Affairs asserted that a large degree of rationalization was imperative in order to save the Walloon (southern and eastern Belgium) steel industry. This included both public and private long term investments, a change of the current product mix (which included only 3% specialty steels compared with 19% in Italy, 17% in the Federal Republic of Germany, and 14% in France), no increase in overall capacity, and large-scale reduction of the work force, which was about 50,000 in 1977.

It appeared almost inevitable that the Belgian Government would be obliged to take a significant equity position in the steel industry, as it did in the Jemappes case, since the debt-equity ratio of many companies was too poor to permit further subsidized credits or credit guarantees. Other Government action would probably be to move workers out of the steel industry into jobs created by new public corporations, as in the MMRA affair discussed later; 20% to 30% of the Walloon steel industry work force (10,000 to 15,000 work-

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ers) was expected to be affected.

The Belgian steel industry, large both by world standards and on a per capita basis, consisted of the Cockerill Group (S.A. Cockerill-Ougrée-Providence et Espérance-Longdoz) based at Liège, with about one-half of the country's capacity; the Frère Group, consisting of three loosely associated firms (Soc. Métallurgique Hainaut-Sambre S.A., Forges de Thy Marcinelle et Monceau S.A., and Laminoirs du Ruau) around Charleroi; and Maritieme Staalnijverheid N.V. (also called Soc. Sidérurgie Maritime S.A. (Sidmar), near Ghent. Smaller firms included Usines Gustave Boël at La Louvière, Forges de Clabecq S.A. at Clabecq, and MMRA.

Nonmetals.—*Cement.*—Belgian production of all types of cement was nearly 7.8 million tons. The largest of the seven companies in the industry were S.A. Cimenteries Cementbedrijven N.V., producing about 3.1 million tons (of which one-half was at the Lixhe plant near Limburg Province of the Netherlands) and Ciments d'Obourg S.A., producing 2.1 million tons (of which 80% was at the Obourg plant near Mons).

Mineral Fuels.—In February, the Government prepared a draft "White Paper" on energy policy. It discussed the major objectives of the Belgian energy program, including energy conservation, utilization of indigenous sources of energy (particularly coal), encouragement of use of nuclear power for electricity generation, and a general reduction in dependence on imported oil. However, in view of the concurrent dissolution of Parliament and the calling of new elections which led to a new coalition government, the broad lines of a comprehensive energy policy were not clearly defined.

Total primary energy balances for Belgium are given for 1975 and 1976 in table 5.

Coal.—The energy policy statement issued in the national budget that was proposed in September called for a review of the corporate statute of Naamloze Vennootschap Kempensche Steenkohlenmijnen, the coal-mining company operating in the Campine (northeastern Belgium), in order to improve public-sector participation. Also, to settle upon a permanent policy for coal from the Campine, a "massive" study would be undertaken of conventional uses and alternatives, including coal chemistry and gasification. Although the Campine mines were operated by a private company, they received continuing heavy Government subsidies. The energy policy statement also indicated that the policy of closing Walloon mines (those in Wallonia, or French-speaking southern Belgium) would be continued.

Natural Gas.—Natural gas shows were encountered between 4,000 and 4,500 meters in a well drilled by Foraky S.A. for the Ministry of Economic Affairs near the town of Saint-Ghislain, west of Mons. Other indications of the presence of natural gas in pre-Permian strata were found in wells at Focant, southeast of Dinant. The Belgian Administration of Mines planned to undertake an exploration program in 1979 that would include drilling a test hole of 6,000 meters in the Famenne region adjoining the Focant area. Two oil companies, including Petrofina S.A., have asked for concessions in Hainaut and the Campine as a result of the foregoing studies.

A decision was made by the Government to construct a floating terminal for liquefied natural gas at Zeebrugge to receive and store 5 billion cubic meters per year from Algeria; this will be needed to supplement diminishing supplies from the Netherlands in the 1980's.

Petroleum.—The 45-centimeter-diameter, 150-kilometer-long pipeline from Antwerp to Limburg and and Liège was completed early in 1978. The pipeline, with an initial capacity of 2.5 million tons per year of feedstocks such as naphtha, gas oil, and benzenes, would supply areas along the way and finally the DSM chemical works at Geleen, near Maastricht, the Netherlands.

Uranium.—The Commission of the EEC had earlier allocated 5 million units of account (about $6 million) over a period of 3 years for uranium prospecting in the EEC. In 1977, exploration and prospecting projects were financed in five countries, including Belgium.

All future projected Belgian electricity-generating plants were to be nuclear. The three reactors in operation in 1977 (1,650 megawatts-electric) accounted for about 21% of total generating capacity. Two additional plants (1,830 megawatts-electric) were under construction and were to be onstream in 1979 and 1980, and two more (2,000 megawatts-electric) were planned for 1982. All were liquid water reactors. A moratorium on the latter two planned reactors was announced by the Government in July.

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Table 5.—Belgium-Luxembourg: Supply and apparent consumption of fuels and power for 1975 and 1976

(Million tons of standard coal equivalent[1])

	Total primary energy	Coal and coke	Petroleum and refinery products	Natural gas	Hydro-electric and nuclear power
1975:					
Production	r9.7	r8.9	--	--	0.8
Imports	r87.0	r8.7	r64.9	r12.9	.5
Exports	r26.5	r.8	r24.8	r.3	.6
Apparent consumption	r370.2	r16.8	r340.1	r12.6	.7
1976:					
Production	8.8	7.6	--	--	1.2
Imports	81.4	8.1	57.9	15.0	.4
Exports	22.8	.7	[2]20.6	.7	.8
Apparent consumption	[3]67.4	15.0	[3]37.3	14.3	.8

rRevised.
[1]1 ton standard coal equivalent (SCE)=7,000,000 kilocalories.
[2]Includes bunkers.
[3]Includes refinery and other losses.

LUXEMBOURG

In 1977, many of Luxembourg's industries regained the prerecession production levels, if not the profitability, of a few years earlier, but the dominant steel industry was not among them. Steel tradionally generates almost one-fourth of the GNP.

By the end of the third quarter, steel production by Aciéries Réunies de Burbach-Eich-Dudelange (ARBED), which contributes 90% of the country's steel output, had fallen 8% below even the low level recorded for the same period of 1976. Steel prices continued to decline, and, while ARBED managed to hold down production costs, financing costs rose; losses for the first 6 months were 2.2 billion Luxembourg francs (Lux F),[2] well above the loss of Lux F1.3 billion for all of 1976. The generally bleak outlook for future sales and profitability was attributed by ARBED's board of directors in October to low-priced imported steel flowing into European markets, which reflected ARBED's loss of competitiveness with Japan and the new exporting nations. To meet the threat to the future, ARBED initiated a crisis plan during the year, centered on reducing production costs by the maximum installation of new equipment within the company's means and the swift reduction of personnel. In 1977, some Lux F4.1 billion was invested, in addition to earlier investments in 1970-76 of Lux F18.7 billion, in a massive gamble that the company could survive a few years until the investments paid off.

The second and only other steel producer in Luxembourg, MMRA, a 1-million-ton-per-year producer, was experiencing even greater difficulties than ARBED. In September, the Prime Minister of Belgium announced a joint Belgian-Luxembourg interim settlement of the problem by closing most of the Athus plant on the Belgian side of the border and reducing employment there from 1,650 to 200, reducing the labor force at Rodange in Luxembourg by 700 but not curtailing operations, and providing BF680 million as operating capital until yearend through a debt and tax moratorium, contributions by the owners, and a Belgian Government advance of BF200 million. The McKinsey study currently underway in Belgium was to serve as a basis for solutions to be agreed upon by the Cockerill and ARBED steel companies, the two Governments, and MMRA. The Governments also agreed to compensate the jobless at Rodange through a special Luxembourg-supported anticrisis division of MMRA and to offer a choice to the Athus workers of early retirement, "job cell" employment in other activities, or dismissal with the usual company, EEC, and Belgian Government compensation. The job cell organization would guarantee most wages of surplus employees for about 3 years, aided by a diversification society that would develop new industry in the region. The Rodange-Athus arrangement was seen as a test case of the objectives of the EEC's Davignon Plan for helping the European steel industry. The Davignon Plan called for restricting production and fixing prices while undertaking substantial modernization programs.

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Table 6.—Luxembourg: Production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Iron and steel:			
Ore and concentrate	2,315	2,079	1,548
Metal:			
Pig iron (including blast-furnace ferroalloys)	3,889	3,756	3,568
Steel:			
Crude	[r]4,624	4,566	4,329
Semimanufactures	[r]3,472	3,592	3,468
NONMETALS			
Cement, hydraulic	343	299	290
Fertilizers, manufactured, phosphatic: Thomas slag, gross weight	[r]747	733	713
Gypsum and anhydrite, crude tons	4,819	1,650	2,693
Quartz, quartzite, glass sand do	29,560	18,115	9,940
Stone, sand and gravel, n.e.s.:			
Sand:			
Molding	3	2	5
Other, industrial	[r]955	729	821
Stone:			
Building stone:			
Rough cut thousand cubic meters	27	7	6
Facing thousand square meters	1	1	NA
Cut stone, crude cubic meters	[r]95	86	67
Gravel	253	208	NA
Dolomite	475	387	407
Paving blocks thousand pieces	13	6	13
Slate slabs thousand square meters	[r]7	6	5
MINERAL FUELS AND RELATED MATERIALS			
Manufactured gas: Blast-furnace gas (0.026 terracalorific/million cubic feet) million cubic feet	263,731	264,808	NA

[p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, Luxembourg also produces refractory clays and manufactured phosphatic fertilizers other than Thomas slag, but data are not published and information is inadequate to make reliable estimates of output levels.

Subsequently, Cockerill and ARBED, at the instance of the two Governments and the EEC, devised a proposal to rescue MMRA permanently. Principal features of the plan, made public at yearend, included progressive integration of MMRA with ARBED, retirement of the 700 affected workers at Rodange by attrition only, nonreplacement of blast furnaces and cancellation of plans for a new rolling mill, an increase in capital to about Lux F1 billion, and participation in MMRA by official credit and investment societies of the two Governments. Assent of the labor unions involved was to be sought after approval of the proposal by the two Governments, but the unions publicly expressed agreement at the time of the announcement.

ARBED's only underground mine operating during the year, Thillenberg, near Differdange, produced siliceous ore. Steel plants were located at Differdange (specializing in the production of wide-flange beams), Esch-Belval (producing heavy sections and strip), Esch-Schifflange (producing merchant bars, etc.), and Dudelange (producing hot- and cold-rolled flat products).

A new cement plant, with a dry-process kiln of 960,000-ton-per-year capacity, was brought into operation by Intermoselle S.A.R.L. at Rumelange. The plant at Esch-sur-Alzette, operated by S.A. des Ciments Luxembourgeois, was converted to a clinker-grinding plant at the same time. No other cement plants operated in Luxembourg.

[1]Supervisory physical scientist, Branch of Foreign Data.

[2]The Luxembourg franc is at par with the Belgian franc.

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The Mineral Industry of Bolivia

By Orlando Martino[1]

In 1977 Bolivia experienced its sixth consecutive year of economic growth, estimated at 4.8%, compared with the 6% to 7% real growth of recent years. The slower growth is attributed chiefly to the decline in agricultural production and the 15% drop in petroleum output. In current dollars the gross domestic product (GDP) grew to the equivalent of $3.6 billion.[2] The rate of inflation was estimated by the Government to have increased to 17% compared with the 12% rate in the 1975-76 period.

The value of output of Bolivia's mining industry accounted for about 6.8% of the GDP. The mining share of gross investment was 8.4%. Benefiting from some increase in production and higher world prices, especially in tin and tungsten, the value of mineral exports grew to $490.5 million, a 30% increase over 1976 exports. However, exports of crude oil declined in value by 40% while natural gas exports increased 22% in value.

The State-owned Corporación Minera de Bolivia (COMIBOL) continued as the largest minerals producer in the country and the largest single tin company in the world. COMIBOL's total mineral sales of $333 million was 30% above 1976 results, reflecting better prices for tin and tungsten, although price declines were incurred for zinc, copper, and bismuth. Despite this improvement, COMIBOL was not able to generate funds to finance adequately its exploration and development programs. COMIBOL's total assets at yearend were valued at $367 million.

In June the Empresa Nacional de Fundiciones (ENAF) completed expansion of its tin smelter at Vinto up to 20,000 tons per year, and by early 1979 was expected to further increase capacity to 30,000 tons with the inauguration of a low-grade tin smelter. In partnership with COMIBOL, ENAF was planning to install a lead-silver smelter-refinery near Potosí.

Yacimientos Petrolíferos Fiscales Bolivianos (YPFB) suffered a 15% decline in crude oil production and a sharp drop in foreign sales. Total sales of $222 million represented a slight increase over those of 1976 but net profit fell 65% to $18.4 million. At midyear YPFB received a credit of $75 million from 34 international banks led by Bank of America to finance construction of petroleum refineries and for exploration and development of its oilfields.

The private mining sector, which has grown steadily since 1952, had a good year because of high tin and tungsten prices. The 31 medium mining companies generated directly or indirectly about $100 million in foreign exchange earnings for Bolivia, and 25% of national mineral output. The medium miners sell over 60% of their tin production to ENAF.

Government Policies and Programs.—In August the Government passed a new law to reduce Bolivia's high dependency on mineral exports by stimulating nontraditional exports—primarily agricultural products—which comprised about 12% of total exports. On April 26, 1977, the Ministries of Mining and Finance issued biministerial Resolution No. 313-77 which extended a 50% reduction on mining export and royalty taxes for additional or "overproduction" for 1977, or until a mining tax reform law is passed. The average of 1972-73 mine production will serve as a basis for determing the amount of overproduction.

A significant advance for the mining industry was achieved with the creation in April 1977 of the National Fund for Miner-

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als Exploration (Fondo Nacional de Exploracíon Minera). The fund, placed under the Ministry of Mines and Metallurgy, will act as a financing agency to promote the discovery of new mineral resources and the quantification of reserves through detailed mine exploration to be carried out by other Government agencies such as the Bolivian Geological Survey and the Nuclear Energy Commission. The fund was granted $12 million from Federal revenues to be disbursed at $1.2 million yearly for 10 years beginning 1978.

In June the Government issued a new petroleum policy to encourage further exploration by foreign oil companies.

PRODUCTION

Of the four commodities, tin, tungsten, antimony, and bismuth of which Bolivia is a producer and exporter of world significance, only mine production of bismuth increased. However, production of metallic tin and antimony increased 43% and 98%, respectively, because of increased smelter capacity. Among the minerals of lesser importance in world supply, mine production of zinc increased 26% and lead increased 18%. Gold output declined 16%. Output of cement continued to be inadequate to meet domestic demand and production of sulfur continued its sharp downtrend.

COMIBOL's total mineral output, summarized in table 1, came from over 90 mines grouped under 12 mining companies. COMIBOL did not suffer from any miners strikes in 1977. After several years of output at a flat level, COMIBOL's tin production increased 13%. All other minerals showed increases, except for cadmium and tungsten.

The production of hydrocarbons has been of growing importance to Bolivia's economy since 1969. The value of its output represented 3.9% of GDP in 1977 compared with 2.6% of GDP in 1971. Although output of crude oil and natural gas decreased, Bolivia was self-sufficient in both energy resources with a sizeable surplus for export.

In 1977 Bolivia employed 81,100 workers in the mining sector or 3.4% of the total labor force. In 1977 COMIBOL employed 24,750 workers and the medium mining companies employed 7,880.

Table 1.—Bolivia: COMIBOL's total mineral output

(Metric tons of fine content unless otherwise specified)

Commodity	1975	1976	1977	Percent share national output
Bismuth	580	536	631	92
Cadmium	138	140	138	79
Copper	3,405	3,415	3,643	93
Gold, troy ounces	412	354	492	2
Lead	11,085	12,556	14,366	74
Silver, thousand troy ounces	4,887	4,951	5,433	87
Tin	20,965	20,626	23,306	71
Tungsten	1,079	1,121	1,056	37
Zinc	31,718	34,046	35,190	57

Table 2.—Bolivia: Principal minerals produced by the Medium Miners[1]

	1976	1977	Percent Change	Percent Share National Output
Antimony	10,937	9,868	-10	63
Lead	712	2,186	+207	12
Tin	6,924	6,967	+1	21
Tungsten	1,557	1,602	+3	53
Zinc	11,031	26,097	+137	42

[1]Produced by 31 companies affiliated with the National Association of Medium Miners founded in May 1939.
Source: Annual Report of the National Association of Medium Miners, July 1977-June 1978.

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TRADE

Bolivia's exports of mineral commodities exceeded the high values obtained in 1974. Mineral exports, not including crude oil and natural gas, accounted for 69% of Bolivia's total exports, compared with a 62% share in 1976. With mineral fuels included, the share of total exports increased to 88%. Of the major commodity exports listed in table 4, only the value of exports of antimony and crude petroleum did not increase in 1977. Although the volume of tin exports increased only slightly in 1977, higher world prices, which increased an average of 27%, provided for a 43% increase in tin export earnings. Thus, the dominant role of tin was enhanced from 37% of total exports in 1976 to 46% by 1977. Because of the drop in output of petroleum and natural gas, the relative importance of these fuels in Bolivia's total trade declined from 27% in 1976 to 19% in 1977.

Imports by Bolivia increased 15% in 1977, giving the country a small surplus in its balance of trade. Bolivia's imports of mineral commodities in 1969, the latest official data available, may be found in the Bolivia chapter of volume 3 of the 1972 Minerals Yearbook. The U.S. share of the Bolivian market increased from 25% in 1976 to 33% in 1977 ($214 million).

On June 14, 1977, Bolivia ratified the fifth International Tin Agreement. The new agreement contained a requirement for an economic and price review by Bolivia and for a systematic and periodic review of buffer stock floor and ceiling tin prices. Bolivia sought to establish an antimony producer's group and scheduled a meeting in April 1978.

Table 3.—Bolivia: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS[1]			
Antimony:			
In ore and concentrate	11,786	15,665	United States 14,539 (distribution of balance unreported).
As metal in alloys	131	1,744	United States 953; Netherlands 496; West Germany 199.
Arsenic, white	10	5	NA.
Beryllium ore, beryllium content of beryl	--	1	NA.
Bismuth:			
In ore and concentrate	28	40	NA.
As metal in alloys	584	264	Belgium-Luxembourg 211; United States 51.
Cadmium in zinc ore and concentrate	156	141	All to United States.
Copper in ore and concentrate	5,991	4,680	NA.
Lead in ore and concentrate	17,665	18,581	United States 10,207 (distribution of balance unreported).
Manganese in ore	371	3,680	NA.
Silver in ore and concentrate thousand troy ounces	6,547	5,687	NA.
Tin:			
In ore and concentrate	18,944	20,487	United States 10,504 (distribution of balance unreported).
In smelter products	7,497	9,868	United States 2,751; U.S.S.R. 1,916; Netherlands 1,913.
Tungsten in ore and concentrate	2,551	3,278	United States 1,709 (distribution of balance unreported).
Zinc in ore and concentrate	49,544	49,206	United States 26,904 (distribution of balance unreported).
NONMETALS			
Barite	1,805	917	NA.
Gypsum	570	191	NA.
Magnesite	60	80	NA.
Sodium sulfate, natural	70	2	NA.
Stone:			
Calcite	85	--	
Sulfur, elemental	21,921	14,881	NA.
MINERAL FUELS AND RELATED MATERIALS			
Gas, natural million cubic feet	55,489	62,000	All to Argentina.
Petroleum, crude thousand 42-gallon barrels	8,283	4,489	NA.

NA Not available.

[1]All data on metal exports are in terms of metal content of material shipped except for arsenic, which is reported in gross weight of white arsenic.

Source: Department of Economic Studies and Statistics. Boletin Estadistica, Nos. 24 and 36, and U.S. State Department Airgrams.

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Table 4.—Bolivia: Leading mineral and mineral fuel exports

(Million dollars, c.i.f. value)

Commodity	1974	1975	1976	1977	Percent of total, 1977	Percent change from 1976 to 1977
Minerals:						
Tin	229.8	181.1	227.9	326.6	46	+43
Zinc	37.3	40.3	39.1	44.7	6	+14
Tungsten	20.9	22.3	34.8	45.1	6	+30
Antimony	29.0	17.1	31.4	18.0	3	-43
Silver	26.8	28.5	24.3	30.8	4	+27
Other	42.2	24.9	21.0	25.3	4	+20
Total	386.0	314.2	378.5	490.5	69	+30
Mineral fuels:						
Petroleum	163.9	114.4	112.6	67.4	10	-40
Natural gas	29.2	42.4	54.6	66.8	9	+22
Total	193.1	156.8	167.2	134.2	19	-20
Other exports	71.4	57.7	65.5	83.4	12	+27
Grand total	650.5	528.7	611.2	708.1	100	+16

Table 5.—Bolivia: Mineral exports by mining groups and smelters

(Metric tons of fine content except as shown)

Commodity	COMIBOL	Medium miners	Small miners	Smelters	Total
Metallic:					
Antimony	--	8,918	3,473	1,431	13,822
Bismuth	--	52	--	483	535
Cadmium	113	37	--	--	150
Copper	2,899	71	204	--	3,174
Iron	--	4,328	--	--	4,328
Lead	14,896	4,765	216	--	19,877
Manganese	--	2,576	--	--	2,576
Silver, thousand troy ounces	5,919	701	106	--	6,726
Tin	12,919	3,108	2,350	12,478	30,855
Tungsten	1,022	1,754	24	--	2,800
Zinc	35,140	23,296	2,920	--	61,356
Alloys, tin	--	--	--	136	136
Alloys, lead	--	--	--	88	88
Nonmetallic:					
Sulfur	--	6,276	--	--	6,276
Barite	--	2,163	--	--	2,163

COMMODITY REVIEW

METALS

Antimony.—Mine output returned to the historical trend following the record high of 1976; nonetheless Bolivia moved to first place as a worldwide producer ahead of the Republic of South Africa. Empresa Minera Unificada S/A (EMUSA) as operator of three antimony mines Chilcobija, Caracota and Espiritu Santo, was Bolivia's largest antimony producer. During 1977 EMUSA produced concentrate with 6,329 tons of antimony content of which 1,950 tons were sold to ENAF and 2,492 tons were exported.

Since its 1976 startup, ENAF's antimony smelter has yet to reach its full capacity of 4,270 tons. ENAF produced 2,322 tons of metallic antimony and 1,411 tons of antimony compounds. Although planning continued on the second 5,600-ton-per-year antimony smelter near Tupiza, the project was delayed because of the weakness in world antimony prices.

Cadmium.—Cadmium has been produced in Bolivia since 1970 as a byproduct of the mining of zinc sulfide ores. COMIBOL's Matilde zinc mine on the east shore of Lake Titicaca was the largest producer with smaller output from New Jersey Zinc Co.'s Huari-Huari operation. About 150 to 300 tons of metallic cadmium was expected to be recovered annually when ENAF's zinc

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smelter begins operations in 1983.

Copper.—The downtrend in the output of copper of the last four years continued. Copper exports in 1977 declined further by 32% to only 3,174 tons. The largest copper project under development was the sinking of the Centauro shaft in COMIBOL's Corocoro mine with a credit from the Development Corp. of South Africa Ltd.

In January the Japanese firm DOWA Mining Co. Ltd. completed a feasibility study for a copper smelter for ENAF with negative conclusions because of Bolivia's small copper production and reserves. However, COMIBOL planned to initiate leaching and electrowinning operations to treat its oxide ores at Corocoro.

Gold.—Cooperatives working in the Tipuani River (55%), and the South American Placers Inc., (SAPI) dredge on the Kaka River (43%), were the main gold producers in 1977, while COMIBOL accounted for only 2% of output. The Tipuani cooperatives requested the Ministry of Mines and Metallurgy to grant concessions in other areas because the areas being worked were nearing depletion. In May 100% of the shares of SAPI were purchased by the Compañía Minera del Sur (COMSUR), the third largest private medium mining company in Bolivia.

Iron Ore.—All of the limited iron ore exports (4,328 tons) during 1977 from Mutún and Villazón went to Argentina, which buys small amounts of iron ore from Bolivia to diversify its large purchases of ore from Brazil. Kaiser Engineering Co. began the geological evaluation of the Changolla iron deposit, a vein-type orebody with a total iron content higher than that of Mutún, but with smaller reserves. The study was expected to be completed by August 1978.

Iron and Steel.—In September Empresa Siderúrgica Boliviana S.A. (SIDERSA) received the feasibility study of the Mutún iron-steel project completed by Arthur G. McKee and Co. Iron ore, with a 56% iron content would be mined from the delineated Mutún orebody at the rate of 1 million tons per year to feed a 4,000-ton-per-day crushing and screening plant. Limestone would be mined locally at a rate of 305,500 tons per year. Direct reduction of the iron ore was recommended by McKee using 10 million cubic feet per day of natural gas available in the Santa Cruz area. However, blast furnace technology using locally produced charcoal remained under consideration as an alternative. The proposed oxygen steel plant would produce 527,400 tons per year of liquid steel. A rolling mill and continuous casting operation were also proposed by McKee.

During August an agreement was reached with Brazil assuring Bolivia a market for 410,000 tons per year of nonflat steel products, about 10% of the Brazilian market. This revised figure represents an increase of 210,000 tons over the original amount set in 1974, and helps make the Mutún project commercially feasible. The steel sale is subject to Bolivia's export to Brazil of natural gas of 240 million cubic feet per day and the future construction of the gas pipeline from Santa Cruz to Corumbá in Brazil at the border.

Lead.—Lead production increased 18% and future output was expected to respond to higher prices and new projects to come on stream in 1978. The largest lead-silver project is by S.J. Groves which was expected to produce 6,000 tons per year of fine lead by 1980.

Following completion of the feasibility study, ENAF in partnership with COMIBOL was planning to construct the first lead smelter in the Western World operating on the Kivcet process. The lead-silver smelter-refinery, estimated to cost $135 million, is to be located in Karachi Pampa 4 miles from Potosí. Technological aspects of the smelter were being handled by KHD Industrieanlagen AG., Cologne, West Germany. Klockner Industrieanlagen GmbH of Duisburg was in charge of commercial and financial matters, and Sidech PBR and Mechim of Belgium were undertaking the refining section inside the Kivcet smelter. Beginning in January 1981, the new plant was expected to produce 24,000 tons of lead and 6.4 million troy ounces of silver.

Silver.—Exports of silver increased 18% over those of 1976. Although production of silver by small and medium miners decreased slightly, output by COMIBOL was up 10%. A new mill was built by COMIBOL at Vetillas to increase the volume of and recovery from silver concentrates from its rich San Vicente mine in the Department of Potosí. Proved and probable reserves of silver of COMIBOL at yearend were 36.2 million troy ounces plus 22.9 million troy ounces in tailings. Total reserves of the private miners were not available.

Tin.—In 1977 Bolivia was the second major exporter of tin in the world. Exports of metallic tin were 40% of total tin exports

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of 30,855 tons. Most tin production came from the nationalized mines operated by COMIBOL (71%), followed by medium miners (21%), and the small mining group and cooperatives (8%). COMIBOL's subsidiary companies of Catavi, Huanuni, Unificada, Quechisla, and Colquiri were the main tin producers among 12 mining companies. Although COMIBOL's mine costs decreased slightly by 2%, overall costs including taxes increased to $4.38 per pound, compared with $3.80 in 1976. World tin prices began the year at over $4.00 per pound and continued rising up to $5.70 per pound by December.[3] Bolivia's tin exports in 1977 increased by less than 2%, but export value increased sharply by 43%, thus contributing 46% of the country's total commodity exports. Western Europe and Japan took 41% of Bolivia's tin exports; the United States, 41%, Latin America 8%, and the centrally planned economy countries, 10%.

COMIBOL continued its program to improve its 50% tin recovery rate. To help overcome this problem, COMIBOL was expected to begin concentration by volatilization in a Soviet-built plant by the revised date of September 1979. Bolivia signed a new contract with Machinoexport of the U.S.S.R. for a second volatilization plant at Machacamarca, 25 kilometers south of Oruro. COMIBOL signed a contract to recover colloidal tin and zinc in a joint venture with Englehardt Mineral Co. COMIBOL's stock of tin at yearend was estimated at 771 tons.

Bolivia continued to increase the amount of tin smelted in the country. ENAF purchased 14,539 tons of tin concentrate, compared with 10,108 tons in 1976. During 1977, ENAF produced 12,788 tons of metallic tin and exported 12,095 tons. The increase in ENAF's tin production above the 9,185 tons in 1976 was due to the increase in its Vinto smelter capacity from 11,500 tons to 20,000 tons when the expanded plant was inaugurated in June 1977. Further expansion up to 30,000 tons was scheduled for January 1979 with the inauguration of the 10,000-ton-per-year, low-grade tin smelter at Vinto. Among the private smelters, Fundicion de Estaño Oruro S.A. (Fundestaño) produced 439 tons of tin (exporting 200 tons) and Bera de Bolivia S.A. exported 3 tons and 224 tons of tin-lead alloys. Fundestaño added a new 50-ton-per-day cyclone furnace and was expanding the capacity of its electrolytic refinery to 3,500 tons of tin in 1979.

On December 27, 1977, ENAF signed a contract with RAZNOIMPORT of the USSR to supply 4,500 tons of metallic tin during 1978. The sales contract was valued at $50 million and represented 25% of ENAF's production. The U.S.S.R. began buying Bolivian tin in 1970, and as of 1976 had purchased a total of 9,553 tons.

The medium miners sold 65% of their tin production (concentrate) to ENAF.

Table 6.—Bolivia: Tin production, exports, and reserves as of December 31, 1977, by major producer

(Metric tons)

Company	Production	Sales to ENAF	Exports	Reserves		
				Proved	Probable	Possible
COMIBOL	23,306	10,066	12,919	[1]208,070	--	344,314
Estalsa Boliviana Ltda	1,736	1,431	254	2,450	4,083	8,167
International Mining Co. (IMCO)	851	56	685	59,500	49,000	45,500
Fabulosa Mines Consolidated	831	418	378	2,600	5,200	16,120
Avicaya Ltda	671	668	--	169,160	130,331	2,906
Yana Mallcu Ltda	516	470	62	NA	NA	NA
Atoroma Ltda	393	380	--	2,407	1,315	1,203
Cia. Minera Orlandini Ltda. (Totoral)	330	319	--	NA	NA	NA
Cia. Minera del Sur (COMSUR)	323	89	195	NA	NA	NA
Pabón Ltda	225	225	--	2,305	1,608	1,824
Cerro Grande Ltda	212	--	209	NA	NA	NA
Barrosquira Ltda	202	137	--	NA	NA	NA
Berenguela Ltda	174	--	164	NA	NA	NA
Soteca Ltda	131	116	--	NA	NA	NA
Empresa Don Vicente	113	35	--	NA	NA	NA
Suka Ltda	81	80	--	1,389	1,573	5,875
Other	2,521	49	[2]15,989	NA	NA	NA
Total	32,616	14,539	30,855	447,881	193,181	426,022

NA Not available.
[1]Proved and probable reserves combined.
[2]Includes exports by ENAF (12,095 tons), private smelters and small miners.

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Tungsten.—Tungsten is one of the four minerals in which Bolivia is a producer of world significance. Following Canada in importance, Bolivia supplied 23% of U.S. imports of concentrate in 1977.

Despite record high price levels in 1977, tungsten exports decreased 15% to 2,800 tons. Output by COMIBOL and small miners declined while that of medium miners increased from 1,557 tons in 1976 to 1,602 tons in 1977, contributing 53% of the country's total. International Mining Co. (IMCO), Bolivia's largest tungsten producer, continued development programs in its Chojlla, Enramada, and Chambillaya mines designed to increase output to 2,200 tons of tungsten per year in 1978. ENAF formed a joint venture with IMCO to produce 2,000 tons of ammonium paratungstate per year. ENAF was expected to issue a construction contract for a ferrotungsten plant in August 1978 to supply the Andean Common Market.

Uranium.—Bolivia has not been a producer or exporter of uranium. In November a pilot plant built by Argentina was inaugurated to process the uranium ore of the Cotaje deposit owned by the Comisión Boliviana de Energía Nuclear (COBOEN). The plant has two leaching cells capable of producing a 66% U_3O_8 concentrate. The number of cells will be increased to six in 1979. Production in 1978 was projected at 1 metric ton of yellow cake. Reserves at Cotaje were estimated at 66,000 tons of ore grading 580 grams of U_3O_8 per ton.

After 3 years of exploration by the Italian firm, S.p.A., results have been disappointing and it appeared its program would be terminated in 1978. COBOEN carried out its own exploration programs and in 1977 made some discoveries in Potosí. COBOEN completed the first stage in 1977 of civil works for a nuclear research center in Viacha near La Paz. A reactor was expected to be installed by 1980.

Zinc.—Mine output of zinc increased 26% but fell short of the 80,000 tons projected for 1977 on the basis of programs by COMIBOL and New Jersey Zinc at its Huari-Huari mine. Questions were raised over the prospect that Bolivia would be able to supply the necessary concentrates for the 100,000-ton-per-year zinc refinery planned for 1983. COMIBOL accounted for 57% of total zinc output, medium miners accounted for 42%, and small mines the remainder. Zinc output by the medium miners increased by 137% in 1977.

ENAF proceeded with its plans to install a zinc refinery in the Department of Potosí. Klockner Industries Anlagen of West Germany was still preparing a feasibility study of the associated zinc smelter and sulfuric acid plant.

NONMETALS

Historically, nonmetallic minerals have been of minor importance in the mineral industries of Bolivia. In this group only exports of sulfur have been of relative significance. Nonmetallic exports have represented less than 0.1 of 1% of total mineral exports.

Barite.—Construction of the barite and bentonite benefication plant at Oruro was completed during the year by the Baroid Div. of NL Industries Inc. in a joint venture with Mosamar of Bolivia, and initial output was expected in early 1978.

Cement.—Cement consumption increased 22% in 1977. Bolivia continued to import some cement; however , projects were being planned to increase cement production significantly in the near future. Limestone and cement production were estimated at 500,000 tons and 267,000 tons, respectively, in 1977.

In 1977, the Inter-American Development Bank approved two loans totaling $48 million (one from the Venezuelan Trust Fund) to help finance Bolivia's fourth cement plant, which will expand the country's cement capacity from 260,000 tons per year to 670,000 tons per year. The plant will be built at Yacuses about 75 miles west of Corumbá on the Brazilian border. Eventual export of cement to Brazil was contemplated.

Fertilizer Materials.—YPFB was planning a joint venture with Brazil for a $200 million fertilizer complex in Puerto Suarez, 500 kilometers east of Santa Cruz. Plans are to build a 1,000-ton-per-day ammonia plant from which a 1,600-ton-per-day urea plant will be fed. The feasibility study was being performed by Japan Consulting Institute and the first draft was received by YPFB in early February. The project is dependent upon the outcome of the negotiations between Bolivia and Brazil regarding the gas pipeline to be built between Santa Cruz and Corumbá.

Salt.—In Bolivia salt is mined primarily at the Salar de Uyuni by mining cooperatives for about $2.50 per ton. Plans have been completed to build an iodized salt plant in Oruro situated 250 kilometers

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north of the Salar, as well as a plant to produce caustic soda (sodium hydroxide).

Sulfur.—The sharp downtrend begun in 1974 continued. Output declined 58% to 6,276 tons, compared with 56,393 tons in 1973. All sulfur production came from mines in the western cordillera of Bolivia.

MINERAL FUELS

Natural Gas.—Production of natural gas decreased 3.2%. There were 250 producing wells in 12 gasfields of which Rio Grande, the largest field had a 2% increase. The greatest declines in output were at Caigua field, 42%; and Guairuy field, 68%. Exports to Argentina, the principal market, increased 4.3% over those of 1976 to 57,887 million cubic feet at a value of $66.8 million (a 22% increase). Negotiations continued on the proposed exports of natural gas to Brazil. Exports of natural gas represented 9.4% of Bolivia's total exports.

In January 1977, Bolivia and Argentina agreed to increase the price of dry gas in five quarterly increments from $0.93 per thousand cubic feet to $1.20 per thousand cubic feet in April 1978. These prices apply to dry natural gas without considering premiums for condensates and natural gasoline. Natural gas sales equaled petroleum export sales in 1977 and were expected to surpass the value of petroleum exports in 1978.

Domestic sales of natural gas increased 16% to 7,288 million cubic feet, but represented only 5% of total gas output. Future domestic consumption of natural gas would rise sharply if the proposed petrochemical complex and the Mutún iron-steel complex are implemented.

Occidental Boliviana Inc., continued to delineate its Tita discovery in the Chaco Basin southeast of Santa Cruz. Twelve of the 13 Tita field wells drilled by yearend contained gas and liquid hydrocarbons. Proven Tita reserves at the end of 1977 have been estimated by consultants DeGolyer and McNaughton at the revised figure of 344 billion cubic feet of gas and 17.2 million barrels of oil and condensate. The Tita discovery proved to be one of the largest gasfields in Bolivia. Production was scheduled to begin in early 1978. An 85-kilometer gas pipeline was under construction by Williams Bolivia S.A. to connect Occidental's gas output with the main Bolivian export line to Argentina by mid-1978. YPFB also completed construction of a crude oil pipeline connecting the Tita field with the oil export pipeline system to the terminal in Arica, Chile. Bolivia has 13 oil and gas pipelines, totaling 3,380 kilometers in length.

Under the production-sharing contract with YPFB, Occidental is entitled to 50% of the oil produced and its part of the gas produced on a sliding scale from 50% to 47% depending on the volume. In October Occidental signed a second production-sharing contract with YPFB covering an additional 1.5 million acres in the southern part of the Chaco Basin.

At yearend total proved Bolivian reserves of natural gas were estimated at 5.7 trillion cubic feet, a 21% increase over the 1976 estimate.

In August, a team from the Japan Natural Gas Association (JNGA) visited Bolivia to develop a program on efficient uses for Bolivia's natural gas resources.

Table 7.—Bolivia: Distribution of natural gas production

(Million cubic feet)

	1975	1976	1977	Percent of total, 1977	Percent change
Injected	60,615	71,442	70,537	47	-1.3
To Argentina pipeline	55,099	55,489	57,886	39	+4.3
Vented and flared	16,590	20,744	13,365	9	-35.6
Local consumption	4,992	6,277	7,288	5	+16.1
Total[1]	137,297	153,952	149,076	100	-3.2

[1]Data may not add to totals shown because of independent roundings.

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Petroleum.—Results were disappointing in 1977. Production of crude oil, which has been in a downtrend since the peak year of 1973, decreased 15% and exports, mostly to Argentina, dropped by 44% to 4.49 million barrels. Oil revenues declined from $113 million in 1976 to $67 million in 1977. The average price for Bolivia's sulfur-free light oil was $13.95 per barrel in 1977. Domestic consumption, which increased by 17% in 1977, reduced further Bolivia's ability to export oil with declining production. There was no price increase for domestic gasoline or other refined products. Output from selected oilfields is shown in table 8. Only three old oilfields increased production. The Espejos and Montecristo fields began production in 1977.

In 1977, drilling decreased 30% over that of 1976 to a total of 34,800 meters, 60% of which was drilled by the State oil company, YPFB. In Southeastern Bolivia, Occidental made an oil discovery in the Techi structure southeast of Tita. A second discovery was made by the group Tesoro Bolivia Petroleum Co., Canadian Superior Oil Ltd., and Zapata Exploration Co. in La Vertiente structure in Southern Bolivia 15 kilometers southeast of Villamontes in the Department of Tarija. Tentative estimates give 200 million barrels of crude oil and 3.5 trillion cubic feet of gas. YPFB discovered a gasfield in the Nupucu structure east of La Vertiente. Southern Bolivia was the second richest oil-gas region after Central Southern Bolivia, the site of most of YPFB activities. Texaco Bolivia Inc., and Getty Oil Co., were the only foreign operators in Northwestern Bolivia, but by April 1977 they had no success and the contract with YPFB was dropped.

During 1977, two new operations contracts were signed by YPFB: one with Occidental covering areas in the departments of Santa Cruz, Tarija, and Chuquisaca and the other with Tesoro for the Tarija area. As of December 1977, Bolivia had signed a total of 19 operations contracts since the General Hydrocarbons Law of 1972. However, at yearend only three foreign groups were active: Occidental, Tesoro, and Phillips Petroleum Co. (Bolivia).

On June 8, 1977, the Government issued a new hydrocarbons policy to encourage further exploration by foreign companies. The new policy provided for: (1) better production sharing for contractors, (2) the possibility of special services contracts to develop production with secondary recovery methods, (3) encouragement of greater use of gas products, and (4) the opening of YPFB reserve areas to exploration by contractors.

At yearend Bolivia's proven petroleum reserves were estimated at 181 million barrels. This figure includes estimates of reserves at Tita and Techi. From geological data this estimate might be increased to over 400 million barrels but stratigraphical problems in fields like Montecristo and Tita make part of the petroleum unrecoverable. La Vertiente requires further drilling to verify early estimates.

Petrochemicals.—The Bolivian petrochemical industry is an emerging industry, helped along by the product assignments of Decision 91 of the Junta de Cartagena of the Andean Common Market (ANCOM) plus the availability of locally produced hydrocarbon feedstock. There are also several projects unrelated to ANCOM that are for the domestic market only or bilateral in nature. The cost of projects to be undertaken during the current fiscal year plan, 1976-80, are estimated at over $400 million. The Stanford Research Institute completed in early 1977 an optimization study for a part of the planned Bolivian petrochemical industry and presented several options to YPFB for proceeding with its investment. No basic petrochemical industry exists in Bolivia, but the plastic industry imports basic raw materials to manufacture finished products. The plastics industry has been an important growth industry over the past several years and the trend should continue.

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[1]Physical scientist, Branch of foreign Data.

[2]Where necessary, values have been converted from Bolivian pesos ($b) to U.S. dollars at the rate of $b 20=US$1.00, as of December 31, 1977.

[3]U.S. Embassy, La Paz, Bolivia. State Department Airgram A-19, Apr. 10, 1978, 57 pp.

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Table 8.—Bolivia: Crude petroleum production by YPFB, by field

(Thousand 42-gallon barrels)

Field	1973	1974	1975	1976	1977
Río Grande	4,856	4,562	4,578	5,412	5,080
Monteagudo	3,465	2,978	2,471	1,867	1,486
La Peña	2,770	2,582	2,069	2,824	2,208
Caranda	2,625	2,034	1,527	1,345	1,165
Colpa	1,892	1,700	1,363	1,029	841
Camiri	695	602	566	559	512
Tatarenda	445	301	235	241	207
Caigua	273	1,651	1,568	1,319	641
San Alberto	83	70	58	52	44
Bermejo-Toro	126	100	83	58	86
Camatindi	28	20	28	31	36
Other	7	3	185	[1]119	[2]367
Total[3]	17,266	16,603	14,732	14,856	12,676

[1]Includes production of Tigre, Guairuy, Buena Vista, Cambeiti, and Los Monos fields.
[2]Includes production of Cambeiti - 177,865 barrels, Espejos - 63,376, Los Monos - 53,782, Guairuy - 35,203, Buena Vista - 19,183 and Montecristo - 17,794.
[3]Data may not add to totals shown because of independent rounding.

Table 9.—Bolivia: Petroleum production, consumption, and exports

(Thousand 42-gallon barrels)

Year	Production	Percent change from previous year	Consumption	Percent change from previous year	Exports	Percent change from previous year
1968	[r]14,973	+3	4,234	+11	[r]10,703	+1
1969	[r]14,757	-1	4,433	+5	10,068	-6
1970	8,820	-40	4,565	+3	[r]3,662	-64
1971	13,446	+52	4,955	+9	8,447	+131
1972	15,967	+19	5,201	+5	10,945	+30
1973	17,266	+8	5,533	+6	11,844	+8
1974	16,603	-4	5,932	+7	10,799	-9
1975	14,732	-11	6,673	+13	8,283	-23
1976	14,856	+1	7,946	+19	8,066	-3
1977	12,676	-15	9,307	+17	4,489	-44

[r]Revised.

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The Mineral Industry of Botswana

By Janice L. W. Jolly[1]

The importance of mineral production to Botswana's economy has increased significantly during the 11 years since independence. Development of mineral resources has been a major factor in the nation's steady positive growth. During the 1978-85 period, minerals were expected to continue to make a major contribution to the economy, sustaining a growth rate in the gross domestic product (GDP) of at least 10% per year.[2] Total mineral production was valued at $144 million[3] in 1977, contributing 28% of the 1977 GDP of about $506 million at current prices.

Previously committed mineral projects were to ensure further growth of the mineral sector. Among these were expansion of the Orapa and Letlhakane diamond mines, opening of a new diamond mine by 1982, and expansion of nickel-copper production capacity. The Government's policy was to allow the private sector to continue to be the primary mechanism for achieving these goals, providing technical and management expertise, marketing channels, and most of the financing for mineral development. The Government would negotiate long-term agreements (up to 25 years) for development, operation, and management of the mines.

The principal policies for guiding mineral development were: The Mines and Minerals Act (Act 30, 1976) which describes the requirements and rights of investors, a negotiated fiscal arrangement suiting the mineral deposit characteristics, direct Government equity participation (normally 15% to 25%) and equivalent board representation, and Government participation (financial and policy) in the provision and operation of infrastructure. In granting mineral exploration licenses, preference was to be given to companies that would explore less developed areas. The Okavango Swamps and Chobe National Park, where ecological systems might be disrupted by mining development, were exempted from exploration efforts. The Government was to escalate regional exploration of the Kalahari Desert, which covers 80% of the country. A recent aeromagnetic survey was made of this area. Exploration was also taking place for asbestos, chromite, and uranium. Small deposits of copper, copper-nickel, and gold that were located by recent investigations were being evaluated.

Results of the completed airborne reconnaissance survey that covered 80% of Botswana were released on October 17 and made available through the Botswana Geological Survey Department (Lobatsi) and the Canadian International Development Agency (CIDA) (Ottawa, Canada). The survey was undertaken by the Geological Survey in association with CIDA. Several large magnetic anomalies were revealed by the exercise.[4]

Botswana's ties with the Republic of South Africa and Southern Rhodesia remained of crucial importance. Botswana relied on the Republic of South Africa for 90% of its imports, for an export route to the sea, and for the substantial revenues derived from its membership in the South African Customs Union. Botswana's share of Customs Union revenues amounted to about $44 million in fiscal 1977-78. In addition, 43,000 workers, about half of the nation's formal labor force (or wage sector), were working in the Republic of South Africa, mostly in the mines. Botswana's

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mines employed 4,500 people, representing 5% of the wage sector employment. The wage sector was 9% of the entire population in 1977.

PRODUCTION AND TRADE

In 1977, Botswana's mineral production consisted of copper-nickel matte, valued at $82.8 million;[5] diamond, valued at $58.6 million; coal, valued at $2.6 million; talc, valued at $41,045; and semiprecious stones, valued at $19,300.[6] The Selebi-Pikwe mine reached full production during the last half of 1977 but continued to face the problem of depressed world market prices for copper and nickel. Diamond prices, on the other hand, were experiencing the effects of renewed demand.

Botswana's diamond output for the first half of 1977 was up 37% over that of the comparable 1976 period. This increase was partly owing to the production of a second mine at Letlhakane which started in late 1976 at an annual rate of 320,000 carats per year. Exports of diamond from the Orapa mine were valued at $38.6 million for the first half of 1977, compared with $27.4 million for the comparable 1976 period. A total of 2.7 million carats was produced in 1977 compared with 2.4 million carats in 1976.

In 1976, Botswana's copper-nickel matte was excluded from the benefits of the 1974 U.S. trade act and Generalized Selected Preference (GSP) eligibility, which would have exempted it from tariffs. Imports into the United States during the first 10 months of calendar year 1977 were valued at $12 million and accounted for 75.6% of total U.S. imports of copper matte. Therefore, Botswana's matte was again excluded from GSP eligibility and was subject to the tariff for the period March 1, 1978, to March 1, 1979, under the competitive need provisions of the act. All of the copper-nickel matte produced at the Selebi-Pikwe mine is shipped to AMAX Inc.'s Port Nickel, La., refinery for processing into metal.

Late in 1977, AMAX wrote off its entire carrying value ($91.7 million) in Botswana RST Ltd., and the debt and marketing arrangements between other investment partners were renegotiated and concluded on March 16, 1978. In 1977, a new sales agreement negotiated between Bamangwato Concessions Ltd. (BCL) and AMAX replaced a previous agreement with Metallgesellschaft A.G. (Federal Republic of Germany). Under the new agreement, all of BCL's product is sold as matte to AMAX. AMAX has undertaken BCL's obligations to sell nickel and copper in the Federal Republic of Germany.

Botswana imported about 700,000 barrels of petroleum products from refineries at Durban in the Republic of South Africa during 1977. During the first quarter of 1977, about 6,500 tons of coal was imported and 86,750 tons of coal valued at $526,446 was produced. Coal imports in 1976 totaled 28,540 tons valued at $269,000.

Table 1.—Botswana: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Cobalt:			
Mine output, metal content	[e]81	[e]157	165
Metal	31	[2]71	[e]80
Copper, Cu content of copper-nickel matte	6,490	12,482	11,788
Nickel, Ni content of copper-nickel matte	6,440	12,579	12,094
NONMETALS			
Diamond:			
Gem[e] thousand carats	360	[r]358	404
Industrial[e] do.	2,037	[r]2,026	2,287
Total do.	2,397	2,384	2,691
Gem stones, semiprecious, rough (not further described) kilograms	65,000	41,000	50,000
Talc	225	[3]144	288
MINERAL FUELS AND RELATED MATERIALS			
Coal (not further described)	71,248	224,175	294,039

[e]Estimate. [p]Preliminary. [r]Revised.

[1]In addition to the commodities listed, modest quantities of crude construction materials (clays, stone, and sand and gravel) presumably are also produced, but output is not reported quantitatively and available information is inadequate to make reliable estimates of output levels.

[2]Sales.

[3]Exports.

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COMMODITY REVIEW

METALS

Copper-Nickel-Cobalt.— During 1977, most of the technical problems at BCL's Selebi-Pikwe mine were apparently solved. BCL is owned 85% by Botswana RST and 15% by the Botswana Government. The recovery of metals from the ore was dramatically improved, increasing from roughly 50% in 1975 to 60% in 1976 and to about 70% in 1977, but there was still substantial room for improvement. A changeover from oil to coal in certain parts of the production process was considered a useful step. Performance in the first 6 months of 1977 was affected by the poor condition of the flash smelter in January and February and normal smelter shutdown in March and April. A major overhaul of the flash furnace was carried out during the shutdown period, and production in the last 6 months set a record high of 19,300 tons, compared with the previous record of 17,300 tons for the second half of 1976. Production of copper-nickel-cobalt matte for 1977 was 30,800 tons compared with 32,500 tons in 1976. Ore milled during 1977 totaled 1.9 million tons, containing 1.02% nickel and 0.83% copper.[7]

Probably the most serious factor affecting the financial performance of BCL in 1977 was the decline in the price of nickel and copper during the year. A serious overproduction of both metals continued to aggravate the problem of large inventories already affecting the world market. As a result, BCL continued to be unable to repay its indebtedness. By December 31, 1977, $151 million in loans had been advanced to BCL, on which about $44 million in interest had accrued. BCL had a net loss of about $46 million in 1977.

The need for major shareholders to invest in BCL was straining cash-starved Zambia Copper Investments Ltd. (ZCI), which had an 11.75% interest in Botswana RST and which was also experiencing the negative effects of the sagging copper market. AMAX took steps to completely write off the carrying value of $91.7 million it had invested in Botswana RST, which was the entire value of AMAX's 29.8% equity in Botswana RST. AMAX had plans to continue making significant cash advances to Botswana RST as the case warranted. Botswana RST's outstanding loans from Kreditanstalt für Wiederaufbau (KFW) and Industrial Development Corp. of South Africa Ltd. were reduced by prepayments without premium. Prepayment of the KFW loan reduced the effects of appreciation of the Deutsche mark. A claim by Triomf Fertilizer (Proprietary) Ltd. against BCL for nondelivery of sulfur by a subsidiary and for cancellation of the contract was settled in 1977 for $3.9 million.

Under a revised agreement, a 3% royalty on the gross value of matte sold by BCL was payable to the Government effective January 1, 1977, on a semiannual basis. This change effectively represented a substantial increase from previous royalty arrangements that provided for a royalty based on profits, subject to a minimum of $905,600 per year. After protracted negotiations between the Botswana Government, the major lenders to BCL, and BCL's principal shareholders, agreements were expected to be announced in 1978 for restructuring of sales and financing arrangements.

NONMETALS

Diamond.—De Beers Consolidated Mines Ltd. and the Government of Botswana agreed to jointly develop the large diamond pipe discovered in 1973 by De Beers at Jwaneng in the southern part of the country. Following the 1975 agreement giving the Botswana Government a 50% interest in De Beers Botswana Mining Co. (Pty.) Ltd. (Debswana), the Government was expected to take up an option to subscribe for a further 20% of Debswana's equity. The Government's equity was to be increased by sharing in the cost of bringing the new Jwaneng mine into production.

Development of the mine and infrastructure was expected to take about 4 years. It was expected to cost about $250 million to bring Jwaneng into production; 10% of the costs was to be financed by export credits, leaving about $45 million for the Government to finance. A loan was to be financed through the First National Bank of Boston and an international consortium of banks, with an average interest rate 2% higher than the London Interbank Offer Rate (LIBOR) on three tranches of $15 million each.

Development of Jwaneng was to include construction of a paved road from Kanye to Jwaneng, a power station, and water and housing provisions for about 2,000 people. The Jwaneng diamond pipe was buried by about 30 to 50 meters of Kalahari sedi-

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ments. Apparently, enough water was located to supply needs during the construction period, but permanent supplies for the mine and township may ultimately have to be piped from near Gaborone. Commercial production was scheduled for 1982 at an initial annual rate of 3.5 million carats, increasing to 6 million carats. Orapa and Letlhakane, also operated by Debswana, are expected to produce approximately 4.8 million carats each under an expansion program to be completed in 1978.

Production from Jwaneng will be sorted in Gaborone by a subsidiary of Debswana, Botswana Diamond Valuing Co. Ltd., and marketed through the Central Selling Organization (CSO). Management of the mine is to be based in Gaborone, with De Beers and Anglo American Corp. Botswana Ltd. responsible for technical services.

The capacity of the Orapa mine was being increased from 2.3 million carats to 4.5 million carats per year by the end of 1978. The Letlhakane mine, which started production in 1976, had worked up to its design capacity of 320,000 carats in 1977 and was also under expansion.

Soda Ash and Salt.—A Japanese economic mission visited Botswana in October to investigate possible cooperation in mining. A Japanese company was reportedly interested in evaluating the Sua Pan salt and soda ash resources, with the possibility of exploitation by 1980.

MINERAL FUELS

Coal.—Botswana was making an effort to become more self-sufficient in coal. Coal production in the first half of 1977 was up 84% over that of the same period of 1976; even so, about 38% of the 1977 coal production occurred in the last quarter. The Morupule colliery produced a total of 294,039 tons in 1977, valued at $2.6 million. The colliery supplies both the Selebi-Pikwe complex and Botswana Power Corp.

Botswana's large coal resources were estimated at about 40 billion tons. As a result of the energy crisis beginning in late 1973, increased interest in Botswana's coal spurred renewed exploration. The initial results confirmed that the coal is of steam coal quality and that it can be washed to produce a low-sulfur, export-quality steam coal product. The lack of adequate transport systems was the major constraint on development of an export market.

Petroleum.—A project to increase Botswana's oil reserve storage capacity to a 3-month supply was underway and would be completed by 1979. The project was expected to cost $4.2 million. The Federal Republic of Germany was to assist in the construction of two depots.

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[1]Physical scientist, Branch of Foreign Data.
[2]The Courier. Mineral Resources and National Development: Three ACP Cases. No. 49, May/June 1978, pp. 75-77.
[3]Where necessary, values have been converted from Botswana pula (P) to U.S. dollars at the rate of P1 = US$1.2075.
[4]Mining Journal (London). Industry in Action. V. 289, No. 7414, p. 245.
[5]Wall Street Journal. Botswana RST Limited, Preliminary Results for the Yearend December 31, 1977 of the Company and Its Subsidiaries. Mar. 20, 1978, p. 23.
[6]U.S. Embassy, Gaborone, Botswana. State Department Airgram A-11, Apr. 25, 1978, p. 1.
[7]Botswana RST Ltd. Annual Report for 1977. Mar. 16, 1978, p. 28.

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The Mineral Industry of Brazil

By Orlando Martino[1]

In real terms, Brazil's gross domestic product (GDP) grew 4.7% in 1977 to $164 billion[2] compared with the 9.2% growth in 1976. The rate of inflation continued high at 39%, a decrease from the 46% rate of 1976.

Although the mineral sector represented less than 2% of the GDP, it accounted for 11% of Brazil's total exports. Production of some 60 minerals and mineral fuels in 1977 was valued at $2.9 billion, a 10% increase at constant prices compared with that of 1976. In the period 1975-77, the value in real terms of mineral output increased at an average annual rate of 12%. The total of $2.9 billion includes mining output and the extraction of coal and petroleum but does not include the value added in the production of refined metals and semimanufactures such as crude steel, ferroalloys, and fertilizer materials. The relative importance of the various mineral groups is shown in the following tabulation:

	Percent of total		Percent change in group value in 1977
	1976[r]	1977	
Metals	35.7	30.1	-8
Nonmetals	30.9	36.5	+30
Mineral fuels	32.4	32.6	+11
Diamond and gem stones	1.0	.8	-12

[r]Revised.

Of the total value of mineral output of $2.9 billion, 10 commodities accounted for 84.5%, as follows: Petroleum (28.3%), iron ore (20.2%), crushed stone (13.8%), limestone (9.2%), coal (2.7%), marine salt (2.6%), pyrochlore (2.2%), manganese (2.0%), tin (1.9%), and natural gas (1.6%).

It was estimated that 76% of Brazil's nonfuel mineral production was in the hands of the Government, some 16% was owned by multinational companies, and about 8% was controlled by private Brazilian investors.

Construction of the Serra dos Carajás iron ore project, designed by the Cia. Vale do Rio Doce (CVRD) to mine up to 50 million tons per year of high-grade iron ore, was stalled during 1977 because of continued weak demand of the world steel industry. Construction work proceeded on the large Trombetas bauxite project in the Amazon basin, with initial output scheduled for 1979.

Planning continued on several aluminum smelter projects under Brazil's ambitious nonferrous development plan, and a resolution about the future of the Tubarão steel plant was expected by early 1978. SAMARCO Mineração S/A's iron ore mining-slurry pipeline-pelletizing operation was initiated in 1977 in Brazil's "Iron Quadrangle."

The State-owned oil company, Petróleo Brasileiro S/A (PETROBRAS) announced the start of a massive, 4-year Strategic Oil Exploration Program designed to establish the extent of Brazil's reserves. Intensified exploration by PETROBRAS resulted in a 27% increase in proven oil reserves by yearend. PETROBRAS signed several risk contracts with foreign oil companies for exploration. During 1977, the National Alcohol Program for gasahol expanded, and experimentation continued at the São Mateus do Sul oil shale recovery plant. PETROBRAS created a new subsidiary company, PETROMIN, to engage in mineral production and marketing, particularly of the large potassium reserves in Sergipe.

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Government Policies and Programs.—The Government pursued a policy of restricted growth and continued to stress two priorities in 1977—reduction of the inflation rate, partly through restraint on investments by companies in the public sector, and improvement in Brazil's international trade situation by expansion of exports and restraint of imports. However, major projects in priority sectors such as minerals and energy development moved actively ahead. Some progress was made in Brazil's nonferrous metals plan, and work started on phase 3 of the steel expansion program. Construction of the cracking unit at the third petrochemical complex in Rio Grande do Sul was begun.

During 1977, the Government decreed a number of modifications of its import restrictions. In June, the prior import deposit was waived on imports of machinery and equipment by Government agencies and State enterprises. In July, petroleum equipment need for development of the Campos basin was exempted for 2 years from the requirement that State enterprises buy Brazilian equipment when available ("Law of Similars"). In September, the requirement of a deposit from importers prior to initiating imports was waived for a number of commodities including copper, lead, zinc, and aluminum scrap. These modifications were not viewed as a significant departure from the Government's import substitution policy but were intended to expedite projects and to be anti-inflationary.

In March, the Government refined its foreign investment policy. The policy, contained in a resolution of the Council for Economic Development, was designed to obtain greater control in selecting foreign investment while seeking to avoid monopoly situations and investment by an excessive number of producers in any given commodity. Investments by foreigners in Brazil's mineral extractive industries played a minor role compared with investments by Brazilian state and private entities. Foreign investment in the mineral extractive industries of Brazil represented only 2.3% or $258 million of the total foreign capital registered by the yearend.

During 1977, additional domestic and foreign investments in Brazil's mineral extractive industries increased 86% to $265 million, allocated as follows: Beneficiation facilities, 67%; mine development, 26%; geological exploration, 4%; and other, 3%. New investment in iron ore production dominated at 40%, followed by phosphates (31%), copper (11%), and other (18%).

As a consequence of exploration efforts by the Government and private entities, the Departamento Nacional da Produção Mineral (DNPM) of the Ministry of Mines and Energy reported substantial increases in the measured reserves of several minerals including silver, lithium, copper, bauxite, graphite, phosphate, kaolin, and petroleum. The geological prospecting subsidiary of CVRD, Rio Doce Geologia e Mineração (DOCEGEO), made promising discoveries of gold and cassiterite at Andorinhas and São Félix do Xingú in the State of Pará. Prospecting by DOCEGEO under the Camaquã project increased copper reserves from 12.7 million tons to 25.5 million tons of copper grading 1.14%.

Two changes were made in the Brazilian mining code administered by DNPM. The first change required payment for a mining claim at the time it is logged. The second provided for decentralization of the licensing procedure for construction materials including sand and gravel. The mapping program started by DNPM in 1971, Radar na Amazonia (RADAM), to assist in evaluating the mineral and economic potential of the Amazon basin was extended to cover the rest of Brazil, and the program was redesignated RADAMBRASIL. DNPM published its detailed program for 1977 covering its activities in mineral economics, control of mining concessions, metallurgical research, basic mapping and exploration, and evaluation of mineral resources.

The Brazilian Government exploration company, Cia. de Pesquisas de Recursos Minerais (CPRM), carried out a diversified program of mineral exploration and geophysical and geochemical studies. From 1970 when operations began until the end of 1977, CPRM drilled a total of 1 million meters. Drilling operations in 1977 focused on the search for uranium, coal, and copper, mostly for the account of Empresas Nucleares Brasileiras S/A (NUCLEBRÁS) and DNPM. CPRM was constructing the Center for Mineral Technology (CETEM) on the campus of the University of Rio de Janeiro that was scheduled to begin operations in mid-1978.

Exploration was also carried out by mineral companies organized and owned by the States of Bahia, Goiás, Mato Grosso, Minas Gerais, Rio de Janeiro, and Rio Grande do Sul.

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PRODUCTION

Following the 1976 pattern, nonmetallic mineral products in 1977 experienced the greatest growth in value, followed by mineral fuels. The metals sector output declined in real value. As a consequence of the continued weak demand in the world iron and steel industry, output of iron ore and manganese ore decreased 13% and 11%, respectively. However, Brazil maintained its rank as the third largest world producer of iron ore after the U.S.S.R. and Australia. The strong upward trend in the production of crude steel continued, with an impressive increase of 22%, and total output of ferroalloys increased 21% to a record high. Ferromanganese output increased 31%.

Brazil continued to make progress in its ambitious nonferrous metals development program but remained dependent on foreign sources for nonferrous metals except tin. For copper, nickel, and zinc metals, demand in 1977 increased at a higher rate than domestic production. The following tabulation below gives the percent changes in 1977 in output and demand compared with 1976 levels.

	Output		Metal demand
	Ore	Metal[1]	
Aluminum	+35	+20	+19
Copper	--	--	+21
Lead	-6	+11	--
Nickel[2]	-20	+18	+23
Tin	+17	+16	+3
Zinc	+61	+9	+12

[1]Primary metal including refined metal from imported concentrate.
[2]In terms of ferronickel.

Among the precious metals, gold output increased 9% and silver output increased more than 15 fold. Monazite concentrate output was up 52%. Production of tungsten concentrate increased 20%, and zirconium increased 52%, both achieving record high production levels.

Continuing its steady growth trend, output of portland cement increased 10%. Notable increases in production of nonmetals included barite 52%, kaolin 24%, graphite 53%, crude quartz 31%, slate 250%, and sulfur 49%. Output of vermiculite increased a dramatic 622%.

Among the fertilizer materials, production of crude phosphate was up 5%, manufactured phosphate 25%, manufactured and nitrogenous fertilizers 26%.

Substantial production declines occurred in bentonite (24%) and crude mica (65%). Of the mineral fuels, gross natural gas output increased 10%, but crude petroleum decreased 7%, continuing a downward trend. Output of metallurgical and steam coal achieved historic highs, increasing 24% and 26%, respectively.

In 1977, total employment in the mineral industry was 65,000 workers, distributed as follows: Iron ore 19%, coal 15%, limestone 12%, mineral water 7%, gold 6%, manganese ore 4%, and tungsten 3%. Mining was most active in the State of Minas Gerais, which accounted for 39% of miners, followed by Santa Catarina with 13%.

Table 1.—Brazil: Production of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Aluminum:			
Bauxite, dry basis gross weight	802,294	826,715	1,119,510
Alumina	267,500	303,000	372,000
Metal, primary	121,400	139,175	167,100
Antimony, metal content	16	35	510
Beryllium: Beryl concentrate, gross weight[2]	646	368	450
Chromium:			
Crude ore	702,167	886,514	683,147
Concentrate	154,465	132,455	250,281
Columbium and tantalum ores and concentrates, gross weight:			
Columbite and tantalite	100	198	137
Djalmaite concentrate	35	24	19
Pyrochlore concentrate	14,605	19,003	15,613

See footnotes at end of table.

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Table 1.—Brazil: Production of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS —Continued			
Copper:			
Mine output, metal content	1,922	54	25
Metal, smelter (blister)	1,308	--	--
Gold, troy ounces	172,038	158,246	172,167
Iron and steel:			
Ore and concentrate (salable), thousand tons	89,894	94,087	82,001
Metal:			
Pig iron, do	5,816	7,053	8,170
Ferroalloys (electric furnace):			
Ferrochromium	52,986	59,730	65,969
Ferrocolumbium	3,996	10,010	6,809
Ferromanganese	86,850	98,738	128,922
Ferronickel	9,646	9,971	10,860
Ferrosilicon	54,276	45,252	60,296
Ferrosilicochrome	2,304	5,880	4,121
Ferrosilicomanganese	38,828	63,843	75,108
Other and unspecified	7,052	14,634	19,172
Total	255,938	308,058	371,251
Crude steel, excluding castings, thousand tons	8,308	9,169	11,164
Semimanufactures, hot-rolled, do	r6,414	7,018	8,412
Lead:			
Mine output, metal content	22,365	22,615	24,039
Metal:			
Primary	37,540	43,672	48,303
Secondary	25,184	28,500	30,000
Manganese ore and concentrate (marketable), gross weight, thousand tons	2,156	1,696	1,516
Nickel:			
Mine output, metal content	3,190	5,273	4,241
Ferronickel content	2,280	2,149	2,530
Rare earth metals: Monazite concentrate, gross weight	1,450	1,610	2,441
Silver[3], thousand troy ounces	235	20	372
Tin:			
Mine output, metal content, thousand tons	5,000	5,900	6,400
Metal, smelter, primary, do	6,600	6,400	7,400
Titanium concentrates, gross weight:			
Ilmenite	4,596	14,615	13,268
Rutile	104	51	128
Tungsten, mine output, metal content	1,132	1,160	1,394
Zinc:			
Mine output, metal content[e]	50,000	48,700	58,000
Metal, smelter:			
Primary	31,428	43,154	47,032
Secondary	8,000	7,000	8,000
Zirconium: Zircon concentrate, gross weight[4]	2,925	3,058	4,649
NONMETALS			
Asbestos, fiber	73,978	92,703	92,773
Barite:			
Crude	53,675	51,238	39,575
Beneficiated	30,196	25,887	39,353
Calcite	12,571	13,397	6,236
Cement, hydraulic (including pozzolanic), thousand tons	r16,736	19,147	21,123
Clays:			
Bentonite	r111,869	143,218	108,395
Kaolin:			
Crude	617,884	710,254	939,666
Beneficiated	172,834	209,704	259,836
Kyanite	230	256	110
Other:			
Crude	2,385,710	3,229,053	3,514,219
Beneficiated	866,530	1,458,139	1,574,765
Diamond:			
Gem[e], thousand carats	131	38	33
Industrial[e], do	131	38	32
Total, do	262	76	65
Diatomite	3,740	5,036	11,204
Feldspar and related materials:			
Feldspar, crude	76,429	85,114	99,767
Leucite	2,449	10,290	10,671
Sodalite	650	643	982
Fertilizer materials:			
Phosphate rock (includes apatite):			
Crude ore, gross weight	r2,846,664	3,256,042	3,424,939
Beneficiated ore, gross weight	406,030	489,617	650,486

See footnotes at end of table.

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Table 1.—Brazil: Production of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
NONMETALS —Continued			
Fertilizer materials —Continued			
Manufactured:			
Nitrogenous (nitrogen content)	160,755	183,858	231,367
Phosphatic (P_2O_5 content)	515,970	813,000	1,019,791
Fluorspar:			
Direct-shipping ore (sales)	61	55	13,162
Beneficiated product	63,919	31,105	53,483
Total	63,980	31,160	66,645
Graphite, all grades	5,260	6,018	9,187
Gypsum and anhydrite, crude	403,847	545,463	543,046
Lime[e] thousand tons	2,000	2,000	4,500
Lithium minerals:			
Amblygonite	156	185	489
Lepidolite	468	1,332	579
Petalite	3,697	968	1,028
Spodumene	792	413	112
Total	5,113	2,898	2,208
Magnesite, crude, gross weight	439,466	414,612	481,154
Mica, all grades[2]	1,100	2,799	1,955
Pigments, crude (ocher)	7,490	5,957	6,630
Precious and semiprecious stones, except diamond, crude and worked:[2]			
Agate kilograms	2,465,994	1,929,158	1,346,803
Amethyst do	248,815	182,324	202,338
Aquamarine do	1,438	559	1,179
Cat's eye value, thousands	$338	$599	$554
Citrine kilograms	24,049	24,250	33,830
Emerald do	2,302	2,991	2,266
Garnet do	307	211	177
Opal do	77	513	342
Ruby value	—	$403	$5,500
Sapphire kilograms	(5)	(5)	—
Topaz do	2,714	4,743	3,850
Tourmaline do	422	2,838	526
Turquoise value	$811	$80	$4,221
Other kilograms	436,944	742,433	524,602
Quartz crystal, all grades[2]	1,672	1,965	1,588
Salt, marine thousand tons	2,145	2,473	2,481
Silica	922	3,620	3,594
Sodium compounds:			
Caustic soda	241,303	257,016	291,212
Soda ash, manufactured	148,133	150,012	141,022
Stone, sand and gravel:			
Dimension:			
Granite thousand tons	16,397	56,077	51,815
Marble	130,055	105,240	145,257
Slate	1,305	1,337	4,670
Crushed and broken stone:			
Dolomite thousand tons	1,654	1,599	1,663
Limestone do	29,588	34,883	39,303
Quartz[6]	25,413	34,821	45,530
Quartzite:			
Crude	276,382	276,036	255,247
Processed[7]	130,502	149,261	148,304
Shale	308,171	326,923	529,449
Sand thousand tons	2,881	3,833	4,875
Sulfur, elemental, byproduct	r19,514	29,864	44,351
Talc and related materials:			
Talc	154,893	151,245	190,178
Pyrophyllite	65,778	74,094	79,284
Other (agalmatalite)	81,478	53,241	85,291
Vermiculite	800	946	6,833
MINERAL FUELS AND RELATED MATERIALS			
Carbon black[e]	91,000	103,000	110,000
Coal, bituminous (marketable) thousand tons	2,846	3,310	e3,500
Coke, metallurgical, all types do	2,204	2,805	3,349
Gas, natural:			
Gross million cubic feet	57,371	57,909	63,835
Marketed do	e24,720	e19,330	37,311
Natural gas liquids thousand 42-gallon barrels	r1,905	1,906	2,050
Petroleum:			
Crude do	64,694	62,932	58,684

See footnotes at end of table.

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Table 1.—Brazil: Production of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS —Continued				
Petroleum —Continued				
Refinery products:				
Gasoline	thousand 42-gallon barrels	88,903	90,013	82,692
Jet fuel	do.	10,636	11,152	11,252
Kerosine	do.	3,988	4,264	4,522
Distillate fuel oil	do.	77,229	87,737	96,624
Residual fuel oil	do.	95,759	98,725	101,800
Lubricants	do.	1,497	2,252	2,378
Other	do.	41,112	44,546	48,898
Refinery fuel and losses	do.	11,140	9,705	9,774
Total	do.	330,264	348,394	357,940

[e]Estimate. [p]Preliminary. [r]Revised.

[1]In addition to the commodities listed, molybdenite and bismuth are also produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2]Exports.

[3]Smelter and/or refined metal.

[4]Includes baddeleyite-caldasite.

[5]Less than 1/2 unit.

[6]This material apparently includes crude quartz used to produce quartz crystal (listed separately in this table) as well as additional unreported quantities of common quartz.

[7]Produced from a portion of the crude quartzite listed; the quantity of crude quartzite processed was as follows: 1975—78,178 tons; 1976—61,542 tons.

TRADE

In 1977, Brazil eliminated its trade deficit that developed during the world energy crisis of 1974. Trade balance was achieved by a 20% increase in total exports to $12.14 billion and a 3% decrease in imports to $12.0 billion.

The mineral trade deficit, however, increased 10% to $4.94 billion, reflecting Brazil's increasing dependence on foreign sources for its nonferrous metals, fertilizer materials, coal, petroleum, and natural gas. Mineral exports decreased 3% from the revised 1976 value of $1.48 billion to $1.44 billion, while mineral imports increased 7% over the revised 1976 value of $5.97 billion to $6.38 billion. Mineral exports, mostly iron ore, manganese, and tungsten, represented 12% of Brazil's total exports; mineral imports, chiefly petroleum, made up 53% of total imports.

The following tabulations show, in percent, the relative importance of the leading mineral ores and fuels in Brazil's international trade. Primary metals and mineral compounds such as fertilizer materials are not included.

Exports	1975	1976	1977
Metals	88.8	93.9	95.4
Iron	80.0	86.0	88.9
Manganese	7.0	5.7	3.1
Tungsten	.8	.6	1.5
Columbium	.7	1.1	1.0
Other	.3	0.5	.9
Nonmetals	1.7	1.0	1.8
Gems and diamonds	2.2	1.9	1.8
Crude	.9	.9	.8
Polished	1.3	1.0	1.0
Mineral fuels	7.3	3.2	1.0
Petroleum	6.5	3.1	.7
Others	.8	.1	.3

Source: DNPM, Anuário Mineral Brasileiro, 1978, p. 36.

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Imports	1975	1976	1977
Metals	1.1	0.7	1.4
Tin	.4	.1	.5
Lead	.1	.1	.3
Molybdenum	.1	.1	.3
Others	.5	.4	.3
Nonmetals	1.8	1.7	1.6
Sulfur	1.0	1.0	.7
Asbestos	.3	.4	.5
Others	.5	.3	.4
Gems and diamonds	.2	.2	.1
Mineral fuels	96.8	97.4	96.9
Petroleum	90.1	91.4	90.6
Coal	6.5	5.5	5.6
Natural gas	.2	.5	.7

Source: DNPM. Anuário Mineral Brasileiro. 1978 p. 36.

Among primary mineral commodities, exports declined for the metallic ore group (11%), diamonds and gemstones (16%), and energy products (73%). In contrast, the value of exports of nonmetallic ores increased by 56% common metals and related semimanufactures, 21% and mineral chemical compounds, 62%. The values of significant mineral commodities in Brazil's international trade are given in the following tabulations, in million U.S. dollars. In most cases, only those commodities with values exceeding $1.0 million have been included.

Mineral exports	1975	1976	1977	Percent change from 1976 to 1977
Iron ore	920.9	995.5	907.2	-9
Steel and ferroalloys	184.5	247.9	286.4	+16
Petroleum derivatives	95.9	21.7	55.9	+158
Manganese ore	80.6	66.0	32.1	-51
Tin, refined	24.9	14.8	27.9	+89
Diamonds and gem stones	24.9	22.8	19.2	-16
Tungsten concentrate	9.4	7.6	15.2	+100
Columbium concentrate	8.1	13.4	10.7	-20
Magnesite	5.8	4.3	8.9	+107
Aluminum metal	4.9	5.2	8.2	+58
Crude petroleum	75.3	36.2	7.3	-80
Chromium: Chromite	--	.5	5.5	+1,000
Copper, refined	2.7	2.1	4.9	+133
Quartz	8.4	4.3	2.3	-47
Cement	1.7	2.2	1.4	-36
Other	64.5	39.3	51.8	+32
Total[1]	1,512.5	1,483.8	1,444.9	-3
Percent of total exports	17	15	12	XX

XX Not applicable.
[1]Includes semimanufactured items and mineral-related compounds.

Source: DNPM, Anuário Mineral Brasileiro. 1978.

Mineral imports	1975	1976	1977	Percent change from 1976 to 1977
Crude petroleum	3,063.4	3,783.9	3,956.5	+5
Steel and ferroalloys	1,445.9	692.1	659.7	-5
Fertilizer materials	304.7	267.7	352.1	+32
Copper, primary	177.3	219.4	265.0	+21
Petroleum derivatives	222.3	307.5	258.6	-16
Coal and coke	223.4	229.4	254.3	+11
Aluminum, primary	75.7	77.7	91.2	+17
Zinc, primary	46.2	41.7	41.2	-1
Sulfur	34.2	41.6	37.1	-11
Natural gas	5.0	22.7	35.7	+57
Asbestos fiber	12.1	17.9	22.0	+23
Magnesium, primary	17.4	18.6	21.3	+15
Titanium ore, metal, pigment	11.6	37.2	20.8	-44
Tin concentrate	14.0	6.1	20.2	+231

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Mineral imports	1975	1976	1977	Percent change from 1976 to 1977
Silver, wrought	10.9	18.7	19.6	+5
Lead concentrate	6.4	7.0	16.4	+134
Molybdenum concentrate	4.3	6.5	13.3	+105
Cement, portland	11.3	16.3	12.3	-25
Gold, unwrought	16.7	11.4	11.9	+4
Nickel, primary	7.2	9.4	11.8	+26
Lead, primary	6.7	4.1	8.3	+102
Manganese ore	1.9	2.0	5.5	+175
Diamond including dust	7.6	7.8	5.2	-33
Chromium	1.0	1.2	2.6	+117
Tungsten	1.3	1.9	2.4	+26
Platinum and alloys	2.4	1.9	2.3	+21
Other	323.7	118.7	228.9	+93
Total[1]	6,054.6	5,970.4	6,376.2	+7
Percent of total imports	44	49	53	XX

XX Not applicable.
[1]Includes semimanufactures and mineral-related compounds.

Source: DNPM, Anuário Mineral Brasileiro. 1978.

Brazil's chief overseas markets for mineral exports were: Japan (21%), the Federal Republic of Germany (13%), the United States (10%), Argentina (5%), and Italy (5%); the chief suppliers of mineral imports were Saudi Arabia (21%), Iraq (18%), the United States (9%), Kuwait (7%), and Iran (6%). In 1977, Japan was Brazil's major buyer of iron ore, and the United States was the leading buyer of manganese ore, columbium-tantalum concentrates, tin metal, ferroalloys, and steel products. Sweden was the principal market for tungsten concentrate (scheelite), and Saudi Arabia and Iraq were the primary suppliers of crude petroleum, which in 1977 represented 62% of all mineral imports.

Brazil and Iran signed a bilateral trade agreement effective June 30, 1977, valued at $6.5 billion over a 5-year period. Brazil agreed to almost quadruple its oil purchases from Iran to $1 billion per year. The oil will be sold at full Organization of Petroleum Export Countries (OPEC) prices. Brazil and Iran will study the formation of joint ventures to manufacture petrochemicals, fertilizers, aluminum, and iron pellets. The supply of copper to Brazil from Iran will also be studied.

Table 2.—Brazil: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]	Principal destinations, 1976
METALS				
Aluminum:				
Bauxite and concentrate	17,777	2,738	3,654	Argentina 2,083; Uruguay 430.
Oxide (alumina) and hydroxide[1]	1,563	69	145	Uruguay 40; Argentina 20; Paraguay 9.
Metal including alloys:				
Unwrought	14	--	--	
Semimanufactures	r588	522	1,010	Chile 169; Peru 153; El Salvador 89; Paraguay 57.
Antimony metal including alloys, all forms	26	20	1	All to Netherlands.
Beryl ore and concentrate	646	r369	450	All to United States.
Chromium:				
Chromite	190	9,128	71,111	West Germany 9,000.
Oxide and hydroxide	(2)	10	1	Mainly to West Germany.
Columbium and tantalum ores and concentrates:				
Columbite[3]	29	3	27	All to United States.
Tantalite	96	127	111	United States 76; Netherlands 32; Japan 12.
Pyrochlore	2,895	4,381	3,310	West Germany 1,507; United Kingdom 1,070; United States 705; Japan 650; Austria 448.
Copper metal including alloys, all forms	806	r446	1,631	Uruguay 180; United Kingdom 100; Venezuela 57.

See footnotes at end of table.

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Table 2.—Brazil: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]	Principal destinations, 1976
METALS —Continued				
Gold metal, unworked or partly worked, all forms troy ounces	418	--	NA	
Iron and steel:				
Ore and concentrate including roasted pyrite thousand tons	72,522	67,086	58,541	Japan 24,798; West Germany 11,591; United States 5,179.
Metal:				
Pig iron	510,524	774,947	850,629	Italy 213,062; West Germany 98,722; United States 83,193.
Sponge iron, powder, shot	59	8,281	277	Italy 6,200; Spain 2,000.
Ferroalloys:				
Ferrochrome	34,469	[r]47,461	46,661	United States 19,450; Netherlands 17,550; Japan 6,000; Canada 4,000.
Ferromanganese	10,080	11,028	33,876	United States 10,500.
Ferromolybdenum	36	2	115	All to Argentina.
Ferronickel	3,838	1,736	415	All to Japan.
Ferrosilicon	4,337	13,298	2,348	United States 11,583.
Ferrocolumbium	4,135	9,155	7,052	Netherlands 2,263; United States 1,920; Italy 1,529; Japan 1,133; United Kingdom 1,016.
Other	[r]4,111	[r]4,121	23,214	United States 3,257; Iraq 830.
Total	[r]61,006	[r]86,801	113,681	
Steel, primary forms	27,692	92,139	113,423	Italy 56,413; Spain 21,683; United States 10,709.
Semimanufactures:				
Bars, rods, angles, shapes, sections	[r]65,227	101,267	217,029	Nigeria 30,328; United States 24,332; Syria 15,064; Puerto Rico 13,756.
Universals, plates, sheets	[r]37,606	37,011	15,494	United States 15,223; Argentina 10,698; Uruguay 8,531.
Hoop and strip	800	572	651	Bolivia 258; Paraguay 150; Uruguay 104.
Rails and accessories	1,064	497	71	Peru 357; United States 139.
Wire	[r]2,282	5,360	1,838	Colombia 2,476; Venezuela 899.
Tubes, pipes, fittings	[r]13,761	31,612	30,186	Uruguay 12,044; United States 5,809; Bolivia 2,743.
Castings and forgings, rough	[r]1,008	610	175	Bolivia 487; West Germany 79.
Lead metal including alloys, all forms	2	[r]5	3	Paraguay 4.
Manganese:				
Ore and concentrate thousand tons	[r]1,558	[r]1,073	560	United States 375; Norway 159; United Kingdom 110.
Oxide	1,179	[r]1,077	1,090	Argentina 873; Colombia 150.
Mercury 76-pound flasks	(2)	[r]1	--	All to Bolivia.
Molybdenum metal including alloys, all forms kilograms	23	12	445	All to Mexico.
Nickel metal including alloys, all forms	11	4	10	Argentina 3.
Platinum-group silver and metals including alloys:				
Platinum group troy ounces	219,750	112,335	1,800	Spain 105,904.
Silver do	218,368	135,708	--	Mainly to Spain.
Rare-earth metals:				
Ores and concentrates, except monazite	849	--	NA	
Oxides	3	1,090	NA	Austria 649; United States 199; United Kingdom 150.
Cerium metal including alloys	212	46	NA	Belgium-Luxembourg 37; Argentina 5; Finland 4.
Tin metal including alloys, all forms	3,494	[r]1,848	2,226	United States 1,271; Argentina 338.
Titanium:				
Ore and concentrate	63	4	13	All to Argentina.
Oxide kilograms	20	140	105	All to Venezuela.
Metal including alloys, all forms do	[r]52	156	116	NA.
Tungsten:				
Ore and concentrate	1,411	1,044	1,354	Netherlands 481; Sweden 365; West Germany 147.
Metal including alloys, all forms	25	8	16	Sweden 6; Mexico 1; United States 1.
Zinc:				
Ore and concentrate	8,510	[r]7,067	6,128	All to France.
Oxide	13	100	22	United States 85; Mexico 15.
Metal including alloys, all forms	[r]1	[r]25	44	NA.

See footnotes at end of table.

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Table 2.—Brazil: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]	Principal destinations, 1976
METALS —Continued				
Other:				
Ores and concentrates	[r]3,729	4,884	632	West Germany 1,510; United States 1,153; United Kingdom 1,075; Japan 662.
Ash and residue containing nonferrous metals	222	761	109	Netherlands 587; West Germany 155.
Oxides, hydroxides, peroxides of metals	[r]57	12	1	West Germany 10; Mexico 2.
Metals including alloys, all forms:				
Pyrophoric alloys	12	189	481	Sweden 65; West Germany 39; Belgium-Luxembourg 22.
Waste and sweepings of precious metals	[r](4)	--	NA	
NONMETALS				
Abrasives, natural, n.e.s.:				
Emery	1	(3)	4	NA.
Grinding and polishing wheels and stones	[r]340	361	635	Singapore 60; Chile 49; Philippines 40; Ecuador 37.
Asbestos	1	(3)	6	All to Mauritania.
Boron materials: Oxide	--	--	(3)	
Cement	46,738	[r]51,641	27,778	Bolivia 36,578; Guyana 15,000.
Clays and clay products (including all refractory brick):				
Crude:				
Bentonite	1,160	600	555	All to Bolivia.
Kaolin	2,845	815	11,470	Mainly to Uruguay.
Other	1,416	475	NA	Uruguay 220; Mexico 216.
Products:				
Refractory (including nonclay brick)	[r]8,704	9,954	9,748	Argentina 4,873; Poland 4,503.
Nonrefractory	30,472	25,569	25,553	Paraguay 16,666; Bolivia 2,573.
Diamond:				
Gem, not set or strung carats	3,875	1,045	--	Belgium-Luxembourg 405; United States 355; Austria 135.
Industrial do	10,570	550	--	Argentina 240; United States 200; Japan 110.
Fertilizer materials:				
Manufactured:				
Nitrogenous	[r]500	30	1	All to Paraguay.
Phosphatic	100	--	450	
Potassic	--	[r](3)	24	All to Bolivia.
Other, including mixed	[r]8,141	8,358	2,060	Uruguay 7,747; Paraguay 611.
Ammonia	121	[r]151	196	Uruguay 126; Paraguay 23.
Fluorspar	11,075	[r]203	1,419	Mainly to Argentina.
Graphite, natural	66	195	1,133	United Kingdom 111; Argentina 53; Spain 20.
Lime	38	38	730	Bolivia 31; Paraguay 7.
Magnesite	40,237	27,919	63,788	Argentina 10,491; Poland 9,000; Peru 2,700.
Mica:				
Crude including splittings and waste:				
Lepidolite	4,146	[r]1,187	1,955	All to Japan.
Other	1,100	[r]2,800	NA	Norway 1,105; United States 1,001.
Worked including agglomerated splittings	(3)	2	(3)	Mainly to United States.
Pigments, mineral: Iron oxides, processed	38	26	NA	Paraguay 24; Bolivia 2.
Precious and semiprecious stones, except diamond, crude and worked:				
Agate kilograms	2,465,994	1,929,158	1,346,803	Japan 745,928; United States 532,980; West Germany 485,359.
Amethyst do	[r]248,815	182,324	202,338	West Germany 58,824; France 39,865; United States 32,224; Italy 18,567.
Aquamarine do	1,438	559	1,179	West Germany 235; Japan 188; United States 61.
Cat's eye do	1	1	1	Mainly to Japan.
Citrine do	24,049	24,250	33,830	France 9,282; Japan 6,453; West Germany 4,378.
Emerald do	[r]2,302	2,991	2,266	United States 1,302; India 528; Hong Kong 473; Switzerland 340.
Garnet do	307	211	177	West Germany 193.
Opal do	77	513	342	Australia 330; United States 129; Hong Kong 51.
Sapphire do	[r](3)	(3)	(3)	NA.
Topaz do	2,714	4,743	3,850	France 1,669; United States 1,517; West Germany 1,182.

See footnotes at end of table.

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Table 2.—Brazil: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]	Principal destinations, 1976
NONMETALS —Continued				
Precious and semiprecious stones, except diamond, crude and worked —Continued				
Tourmaline ____ kilograms	422	2,838	526	France 1,847; Japan 755.
Turquoise ____ do	101	(2)	(2)	NA.
Other ____ do	436,944	742,433	524,602	West Germany 211,838; Japan 182,910; United States 78,413; Hong Kong 76,796.
Quartz crystal:				
Electronic and optical grade	1,672	1,965	NA	U.S.S.R. 567; Japan 417; United States 304; West Germany 261; Netherlands 195.
Other	177	73	NA	Japan 32; Hong Kong 16; France 11; West Germany 8; Austria 5.
Salt	32,421	1	(2)	All to Bolivia.
Sodium and potassium compounds, n.e.s	7,777	5,328	4,153	Argentina 4,750; Paraguay 570.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	25,635	19,158	57,453	Italy 10,485; Japan 4,960; Spain 2,139.
Worked	8,355	15,838	7,607	Italy 7,157; Japan 7,155.
Dolomite, chiefly refractory grade	558	875	797	Argentina 725; Colombia 150.
Quartz and quartzite	192	17	1,610	All to Netherlands.
Sand, excluding metal bearing	1,934	2,763	996	Mainly to Paraguay.
Sulfuric acid, including oleum	90	289	400	Do.
Talc, steatite, soapstone, pyrophyllite	209	247	189	Argentina 108; Paraguay 72; Colombia 42.
Vermiculite	1	--	45	
Other:				
Crude	90	(2)	874	Mainly to Bolivia.
Slag, dross, and similar waste, not metal bearing, from iron and steel manufacture	15	--	--	
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	r1	35	6,214	Paraguay 28; Bolivia 7.
MINERAL FUELS AND RELATED MATERIALS				
Carbon black	6	12	3	Bolivia 8; Paraguay 4.
Coal and briquets	27	58	234	Paraguay 50; Uruguay 8.
Hydrogen and rare gases ____ kilograms	1,891	2,667	2,298	Mainly to Uruguay.
Petroleum:				
Crude and partly refined thousand 42-gallon barrels	8,079	r19,219	12,011	Argentina 9,011; Peru 6,769; Bahamas 3,209.
Refinery products:				
Gasoline, motor ____ do	r1,521	124	1,572	Mainly to Peru.
Kerosine ____ do	r400	16	177	Do.
Distillate fuel oil ____ do	2,975	715	1,348	Argentina 489; Peru 226.
Residual fuel oil ____ do	2,156	465	208	Uruguay 209; Bahamas 164; Paraguay 92.
Lubricants ____ do	r7	18	14	Paraguay 11; West Germany 4; France 2.
Mineral jelly and wax ____ do	3	(2)	6	Mainly to Mauritania and Bolivia.
Other:				
Liquefied petroleum gas ____ do	804	75	203	All to Surinam.
Nonlubricating oils ____ do	34	1	18	Mainly to Paraguay.
Pitch ____ do	15	--	18	
Petroleum coke ____ do	5	2	--	All to Paraguay.
Bitumen ____ do	71	--	135	
Bituminous mixtures ____ do	1	2	5	Mainly to Paraguay.
Unspecified ____ do	(4)	--	(2)	
Total ____ do	r7,992	1,418	3,704	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	116	82	757	Paraguay 62; Uruguay 20.

[p]Preliminary. [r]Revised. NA Not available.
[1]Includes alumina gel.
[2]Less than 1/2 unit.
[3]Includes some tantalum.
[4]Revised to none.

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Table 3.—Brazil: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977 [p]	Principal sources, 1976
METALS				
Aluminum:				
Bauxite and concentrate	12,988	14,017	12,364	Guyana 13,489.
Oxide (alumina) and hydroxide	10,674	3,335	1,939	Jamaica 2,500; West Germany 434.
Metal including alloys:				
Scrap	[r]2,382	[r]4,043	8,432	United States 3,146; Norway 492.
Unwrought	64,848	[r]78,108	80,819	West Germany 24,579; Canada 13,300; Norway 7,305.
Semimanufactures	12,022	14,231	14,772	United States 7,421; France 2,074; West Germany 1,742.
Antimony:				
Ore and concentrate	1,597	1,721	433	Bolivia 1,677.
Metal including alloys, all forms	47	129	81	NA.
Arsenic:				
Trioxide, pentoxide, acids	749	[r]1,354	654	Mexico 763; France 236; West Germany 204.
Metal including alloys, all forms	17	38	34	United States 15; Sweden 13; Belgium-Luxembourg 10.
Beryllium metal including alloys, all forms kilograms	[r]35	--	--	
Bismuth metal including alloys, all forms	21	NA	NA	
Cadmium metal including alloys, all forms	74	NA	NA	
Chromium:				
Chromite	9,300	[r]12,233	18,197	Philippines 11,000; Republic of South Africa 1,232.
Oxide and hydroxide	113	[r]223	371	Poland 123; West Germany 95.
Metal including alloys, all forms	[r]28	35	60	NA.
Cobalt:				
Oxide and hydroxide	50	[r]94	78	United Kingdom 56; Belgium-Luxembourg 17; United States 12.
Metal including alloys, all forms	148	289	237	NA.
Columbium and tantalum: Tantalum metal including alloys kilograms	52	--	--	
Copper:				
Copper sulfate	2,212	3,718	3,328	Chile 1,952; Peru 1,763.
Metal including alloys:				
Scrap	215	266	681	Bolivia 259.
Unwrought	[r]127,532	[r]150,555	182,439	Chile 138,296.
Semimanufactures	[r]2,314	[r]1,852	2,162	United States 1,046; West Germany 322; United Kingdom 144.
Gold metal, unworked or partly worked troy ounces	111,788	NA	NA	
Iron and steel:				
Ore and concentrate	17	[r]8	10	United States 5; West Germany 2.
Metal:				
Scrap	17,587	2	38	United States 1.
Sponge iron, powder, shot	4,207	5,888	6,199	United States 4,038; West Germany 1,542.
Ferroalloys	[r]6,639	2,439	16,644	United States 1,119; Republic of South Africa 408.
Steel, primary forms	[r]860,767	67,407	39,335	Canada 34,520; Italy 19,999; Japan 12,621.
Semimanufactures:				
Bars, rods, angles, shapes, sections	[r]318,773	109,041	41,245	Japan 19,934; Republic of South Africa 17,261; West Germany 15,286; United States 14,972.
Universals, plates, sheets thousand tons	1,288	692	651	Japan 248; Spain 114; West Germany 95.
Hoop and strip	43,118	25,758	36,110	Japan 9,573; West Germany 6,916; United States 3,125.
Rails and accessories	224,024	166,584	115,813	Poland 82,278; Japan 53,374; United States 17,612.
Wire	22,866	5,541	8,059	Uruguay 1,932; Japan 1,103; West Germany 824; Sweden 553.
Tubes, pipes, fittings	125,781	62,637	55,767	United States 22,936; Japan 14,673; West Germany 7,757.
Castings and forgings, rough	6,723	2,100	3,492	West Germany 1,687; Uruguay 219.
Lead:				
Oxide	678	1,793	1,669	Mexico 1,381; Argentina 326.
Metal including alloys, all forms	16,708	[r]9,190	14,861	Mexico 5,287; Peru 2,786; Argentina 1,064.

See footnotes at end of table.

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Table 3.—Brazil: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]	Principal sources, 1976
METALS —Continued				
Magnesium metal including alloys, all forms	10,630	10,356	11,222	United States 5,762; Norway 4,554.
Manganese:				
Ore and concentrate	17,682	[r]18,275	65,997	United States 1,825; Gabon 16,149.
Oxide	101	108	141	Japan 103.
Metal	[r]308	[r]515	797	NA.
Mercury 76-pound flasks	[r]4,810	5,184	4,394	Mexico 4,959.
Molybdenum:				
Ore and concentrate	1,063	1,413	2,169	Chile 1,293.
Metal including alloys, all forms	20	[r]34	29	United States 16; West Germany 8; Netherlands 7; Austria 3.
Nickel:				
Matte, speiss, similar materials	(1)	--	--	
Metal including alloys:				
Unwrought	1,500	1,894	2,309	United States 902; Netherlands 249; Japan 236; Finland 210.
Semimanufactures	923	[r]1,005	938	United States 331; France 227; Sweden 144; West Germany 131.
Platinum-group metals including alloys, all forms:				
Platinum metal troy ounces	[r]6,720	[r]4,180	22,891	NA.
Other, including platinum alloys thousand troy ounces	[r]33	NA	NA	
Selenium, elemental	13	17	NA	Mexico 8; Netherlands 4; Chile 2; United States 2.
Silicon metal	2,291	311	NA	Norway 209; Italy 100.
Silver metal including alloys thousand troy ounces	2,480	[r]4,451	42,819	Mexico 1,669; Peru 1,478; United States 497.
Sodium metal	37	29	NA	West Germany 27; United Kingdom 2.
Tellurium, elemental kilograms	11	777	NA	Canada 500; Peru 227.
Tin:				
Ore and concentrate	3,137	1,493	3,911	Bolivia 1,344; West Germany 149.
Oxides	122	141	132	United Kingdom 76; West Germany 57.
Metal including alloys, all forms	34	[r]36	7	Panama 20; Bolivia 11.
Titanium:				
Ore and concentrate:				
Ilmenite	15,233	41,250	69,631	All from Australia.
Rutile	3,216	[r]4,800	2,066	Mainly to Australia.
Oxide	1,300	[r]4,369	5,866	West Germany 2,584; United Kingdom 656; France 497.
Metal including alloys, all forms	56	156	116	NA.
Tungsten metal including alloys, all forms	21	25	27	United States 12; West Germany 5; Austria 3; Netherlands 3.
Uranium and thorium oxides including rare-earth oxides	133	73	67	United States 58; France 9; West Germany 5.
Vanadium:				
Oxide	330	358	NA	Republic of South Africa 199; West Germany 88; Finland 71.
Metal including alloys, all forms	8	NA	NA	
Zinc:				
Ore and concentrate	24,836	[r]29,799	--	Canada 15,239; United States 14,560.
Oxide	98	121	91	United States 86; West Germany 35.
Metal including alloys:				
Unwrought	50,332	[r]54,092	58,479	Mexico 33,031; Peru 19,838.
Semimanufactures	312	[r]5	15	Mainly from West Germany.
Zirconium and hafnium:				
Ore and concentrate	6,903	10,864	7,640	Australia 7,373; Malaysia 2,034; United States 1,341.
Metal including alloys, all forms	(1)	--	--	
Other:				
Ash and residue containing nonferrous metals	2,241	4,573	8,892	United States 4,328.
Oxides, hydroxides, peroxides of metals, n.e.s	1,631	2,121	2,440	United Kingdom 736; West Germany 699; United States 465.
Wastes and sweepings of precious metals kilograms	22	NA	NA	

See footnotes at end of table.

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Table 3.—Brazil: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977 [p]	Principal sources, 1976
METALS —Continued				
Other —Continued				
Metals including alloys, all forms:				
Alkali and alkaline-earth metals, n.e.s ____ kilograms__	[r]510	793	44	All from United States.
Pyrophoric alloys ____	6	3	5	All from France.
Base metals including alloys, all forms, n.e.s ____	[r]661	1,356	1,616	Mexico 262; Republic of South Africa 251; Japan 250; United States 179; Belgium-Luxembourg 178.
NONMETALS				
Abrasives, natural, n.e.s.:				
Pumice, emery, natural corundum, etc	999	[r]454	1,170	Italy 204; United States 162; Japan 60.
Dust and powder of precious and semiprecious stones __ kilograms__	207	[r]367	324	West Germany 161; United Kingdom 149.
Grinding and polishing wheels and stones ____	888	393	284	United States 144; West Germany 132.
Asbestos ____	29,800	[r]33,882	39,198	Canada 22,725; Republic of South Africa 7,684.
Barite and witherite ____	221	[r]254	165	West Germany 134; United States 72; United Kingdom 45.
Boron materials:				
Crude natural borates ____	8,628	10,951	12,591	Argentina 9,640; Netherlands 1,310.
Oxide and acid ____	3,428	4,702	3,710	United States 3,433; Argentina 1,248.
Bromine ____	87	29	NA	Israel 18; United States 10.
Cement ____	234,902	[r]337,596	260,645	Uruguay 244,357.
Chalk ____	1,609	2,401	1,523	France 1,311; Sweden 495; Belgium-Luxembourg 400.
Clays and clay products (including all refractory brick):				
Crude:				
Bentonite ____	13,099	[r]14,045	__	United States 7,592; Argentina 6,232.
Kaolin ____	4,889	[r]15,105	25,041	Mainly from United States.
Andalusite, kyanite, sillimanite _	246	244	NA	France 200; West Germany 40.
Other ____	3,666	2,514	NA	United States 1,913; Japan 592.
Products:				
Refractory (including nonclay brick) ____	33,364	10,718	25,132	Japan 3,036; United States 2,821; West Germany 1,791; United Kingdom 1,197.
Nonrefractory ____	1,483	2,200	5,358	Uruguay 1,211; Italy 554; Spain 430.
Cryolite and chiolite ____	2,498	[r]2,901	2,430	Mainly from Denmark.
Diamond (excluding dust):				
Gem, not set and strung ____ value__	[r]$2,291,801	[r]$1,200,968	$1,016,025	Belgium-Luxembourg $823,076; United Kingdom $296,846.
Industrial ____ carats__	350,000	[r]425,000	410,000	United States 240,000; Ireland 95,000; Spain 40,000.
Diatomite and other infusorial earth ___	1,914	1,554	2,126	Mexico 620; United States 514; West Germany 409.
Feldspar and fluorspar ____	1	2	21	All from Sweden.
Fertilizer materials:				
Crude:				
Nitrogenous ____	19,920	33,827	44,306	Mainly from Chile.
Phosphatic ____	887,175	[r]1,434,440	[r]1,617,126	United States 678,360; Morocco 601,367.
Manufactured:				
Nitrogenous ____	613,326	[r]897,084	1,354,654	United States 323,750; West Germany 195,127; Japan 132,001; Netherlands 130,085.
Phosphatic:				
Thomas slag ____	18,165	10,395	18,530	Belgium-Luxembourg 5,445; Egypt 4,950.
Other ____	517,629	515,348	500,100	United States 394,941; Portugal 49,203.
Potassic ____	931,488	[r]1,204,088	1,606,471	United States 554,725; Canada 199,900; East Germany 191,638.
Other including mixed ____	487,314	401,178	513,401	United States 327,156.

See footnotes at end of table.

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Table 3.—Brazil: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977 [p]	Principal sources, 1976
NONMETALS —Continued				
Fertilizer materials —Continued				
Ammonia	[r]77,770	169,875	220,003	United States 61,630; Venezuela 39,343; Iran 28,760; Kuwait 21,087.
Graphite, natural	142	[r]109	48	Madagascar 26; West Germany 26; United States 26; United Kingdom 25.
Iodine	[r]57	127	NA	Chile 93; Japan 25.
Lime	40	77	529	Belgium-Luxembourg 50; Uruguay 20; Venezuela 7.
Lithium materials	25	[r]53	NA	Argentina 50.
Magnesite	160	94	109	Italy 90.
Mica:				
Crude, including splittings and waste	2	[r]4	1	Italy 2; Norway 1; United States 1.
Worked, including agglomerated splittings	66	135	70	United States 57; Switzerland 51; France 22.
Pigments, mineral, including processed iron oxides	2,011	2,244	NA	West Germany 1,990.
Precious and semiprecious stones, except diamond kilograms	[2]1,259	[r]693	168	West Germany 618; United States 89.
Pyrite, gross weight	120	214	171	West Germany 160; United States 54.
Salt and brine	143	5	69	Mainly from United Kingdom.
Sodium and potassium compounds, n.e.s.:				
Caustic soda	[r]267,001	[r]307,522	277,356	United States 171,666; France 67,125.
Caustic potash and sodic and potassic peroxides	2,084	6,068	3,353	United States 2,581; Italy 2,340.
Sodium carbonate (soda ash)	63,001	[r]72,805	NA	France 33,994; Netherlands 10,000; United Kingdom 7,999; West Germany 7,600.
Sodium sulfate	95,596	96,397	NA	Mexico 89,494.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked:				
Calcareous	453	[r]256	296	Uruguay 105; Italy 88; Argentina 56.
Other	65	[r]121	22	Mainly from Uruguay.
Worked	44	[r]52	58	Italy 39; Portugal 11.
Dolomite, chiefly refractory grade	1,770	[r]2,198	2,880	Italy 1,796; Uruguay 400.
Gravel and crushed rock	510	[r](1)	--	All from United States.
Quartz and quartzite	273	12	--	Sweden 5; Switzerland 5; United States 2.
Sand	324	900	90	United States 862.
Sulfur:				
Elemental:				
Other than colloidal	410,227	[r]608,826	658,664	Canada 247,683; United States 175,809; Netherlands Antilles 65,359.
Colloidal	202	[r]221	218	United States 208.
Sulfur dioxide	4	[r]12	50	Argentina 10; West Germany 1; Italy 1.
Sulfuric acid, including oleum	67,016	84,458	58,102	West Germany 35,602; Norway 32,159.
Talc, steatite, soapstone, pyrophyllite	79	[r]174	122	United States 113; Norway 61.
Other:				
Crude:				
Meerschaum	(1)	(1)	--	All from Italy.
Other	358	545	673	United States 365; Argentina 180.
Slag, dross, similar waste, not metal bearing	--	[r]1,103	388	West Germany 902; Republic of South Africa 192.
Oxides and hydroxides of magnesium, strontium, barium	1,743	2,990	2,129	Japan 2,308; United States 370.
Building material of asphalt, asbestos, and fiber cement, and unfired metals, n.e.s	317	308	866	United States 175; United Kingdom 70; Japan 49.

See footnotes at end of table.

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Table 3.—Brazil: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	709	684	267	United States 579; Argentina 105.
Carbon black	6,531	5,273	4,711	West Germany 1,692; Argentina 1,680; United States 1,117.
Coal, all grades including briquets thousand tons	2,762	[r]3,174	3,563	United States 1,951; Poland 1,163.
Coke and semicoke	170,211	[r]125,645	124,513	West Germany 75,349; United Kingdom 24,906; Belgium-Luxembourg 14,700.
Hydrogen and rare gases	6	6	36	United States 5; Canada 1.
Peat, including peat briquets and litter	5	9	--	All from West Germany.
Petroleum:				
Crude thousand 42-gallon barrels	[r]255,494	[r]295,947	259,469	Iraq 92,554; Saudi Arabia 89,917; Kuwait 36,660.
Refinery products:				
Gasoline do	[r]764	[r]590	705	Netherlands Antilles 372; Venezuela 216.
Kerosine do	[r](1)	(1)	(1)	Mainly from United States.
Distillate fuel oil do	[r]543	[r]816	894	Venezuela 501; Netherlands Antilles 159; Bahamas 156.
Residual fuel oil thousand 42-gallon barrels	[r](1)	[r]3,819	403	Netherlands Antilles 1,259; Kuwait 959; Venezuela 622; United States 434.
Lubricant including grease do	[r]2,117	[r]2,023	1,967	United States 1,067; Netherlands 494; Venezuela 345.
Mineral jelly and wax do	[r]95	69	19	Singapore 20; East Germany 15; West Germany 12; United States 12.
Other:				
Liquefied petroleum gas do	328	1,639	2,283	Venezuela 578; Saudi Arabia 524.
Nonlubricating oils, n.e.s. do	6,201	8,048	3,616	Saudi Arabia 4,805; Kuwait 2,641.
Pitch do	32	11	3	Mainly from United States.
Petroleum coke do	217	111	280	United States 67; United Kingdom 44.
Bitumen and other residues do	124	1	(1)	All from United States.
Bituminous mixtures, n.e.s. do	9	3	3	United States 2; United Kingdom 1.
Unspecified do	--	3	--	Mainly from West Germany.
Total	[r]10,430	[r]17,133	10,173	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals thousand tons	129,335	134,406	180	United States 108; Venezuela 18.

[p]Preliminary. [r]Revised. NA Not available.

[1]Less than 1/2 unit.

[2]Partial figure excludes unspecified quantity valued at $247,790. Quantity reported is valued at $585,148.

COMMODITY REVIEW

METALS

Bauxite, Alumina, Aluminum.—Output of bauxite increased 35% to a record high. Most production came from mines in the State of Minas Gerais operated by Companhia Mineira de Aluminio (ALCOMINAS), Alcan Aluminio do Brasil S.A. (ALCAN), and Companhia Brasileira de Aluminío (CBA). Construction continued on the Trombetas bauxite project in the Amazon basin under a consortium of Brazilian, Dutch, Norwegian, Spanish, and U.S. companies, which comprise Mineração Rio do Norte S/A. Initial production, at a rate of 1.4 million tons per year, was expected by early 1979. Trombetas deposit discovered in 1967 has an estimated 600 million tons of

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the trihydrate form of bauxite with an average alumina content of 55%; trihydrate is more economical to process than the monohydrate form.

Other bauxite deposits in the Amazon region contain an additional 2 billion tons of ore, and exploitation plans are in various stages. As of yearend 1977, DNPM reported an 11% increase in total Brazilian measured reserves of bauxite, which totaled 1.93 billion tons grading 55% Al_2O_3 located chiefly in the Amazon region.

Alumina totaling 345,000 tons was produced by three Brazilian companies—CBA, ALCAN, and ALCOMINAS—utilizing bauxite from their mines in Minas Gerais. Aluminio do Norte SA (ALUNORTE), a joint venture of CVRD and a 32-company Japanese group, was developing a $500 million, two-stage alumina plant near Belém, Pará. First-stage output of 800,000 tons per year of alumina was planned for 1983, with the second-stage output of 1.2 tons projected for 1985. Most of ALUNORTE's production was destined for the associated aluminum smelter of Aluminio Brasileiro SA (ALBRAS).

Although production of primary aluminum increased 20% to a record high, it was still necessary for Brazil to import primary aluminum. In 1977, 62,000 tons of primary aluminum valued at $91.2 million was imported principally from the Federal Republic of Germany and the Republic of South Africa. All three aluminum producers, CBA, ALCAN, and ALCOMINAS, were involved in major expansion projects to increase capacities as indicated in the following tabulation, in thousand tons:

	1977	1980	1985
CBA	48	90	120
ALCAN	60	88	138
ALCOMINAS	60	90	120
Total	168	268	378

Three other primary aluminum smelters were under development or in advanced planning stages as listed in table 4. ALBRAS, the largest project, is a joint venture of CVRD and Japanese interests. Its aluminum production will be marketed in Brazil (51%) and in Japan (49%).

Table 4— Brazil: New aluminum smelters under development

Company	Smelter location	Annual capacity (thousand tons)	Startup date	Project cost (million U.S. dollars)
ALBRAS	Belem, Para	[1]40	1983	1,100
Aluminio do Sul S/A (VELESUL)	Rio de Janeiro	80	1981	248
ALUNORTE	Recife, Pernambuco	80	1986	NA

NA Not available.
[1]ALBRAS' planned capacity for 1987 is 320,000 metric tons per year.

Chromium.—Although mine production of chromite decreased 23%, output of chromium concentrate increased 89% to a record high. Exports of concentrate increased sharply from 9,128 tons in 1976 to 71,111 tons in 1977 and were shipped entirely to Japan. Brazil exported 46,661 tons of ferrochromium valued at $19 million, the country's second most valuable ferroalloy traded after ferrocolumbium.

Columbium.—Brazil remained the world's largest producer of columbium minerals. Pyrochlore ore production increased to a record high of 796,000 tons, but the concentrate of Nb_2O_5 decreased 18% to 15,613 tons. There were only two pyrochlore producers in 1977—Companhia Brasileira de Metalurgia e Mineração (CBMM), which produced 13,082 tons of concentrate from its mine at Araxá, Minas Gerais; and the recently established Mineração Catalão de Gerais S/A, which produced 2,531 tons of concentrate at Ouvidor, Goiás. The Cia. de Estanho São Joáo Del Rey produced tantalite and columbite ore and concentrate.

Exports of ferrocolumbium declined 23% to 7,052 tons, but its value of $42.3 million made ferrocolumbium Brazil's most valuable ferroalloy export. Major markets for ferrocolumbium in 1977 were the United States (34%), the Low Countries (21%), and Japan (12%).

Copper.—Brazil continued to depend entirely on imports to meet its demand for primary copper. Imports of primary copper in 1977 increased 21% to 182,439 tons at a

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cost of $265 million. The electrolytic copper came primarily from Chile (88%) and Peru (9%). Secondary copper production from scrap totaled 45,900 tons, an increase of 17% over that of 1976. At yearend, measured copper reserves increased 18% to 53 million tons of ore with an average grade of 1.2%.

The Eluma Corporation, a private group based in São Paulo, received Government permission to construct a 150,000-ton-per-year smelter in the State of Rio Grande do Sul. The smelter, to be supplied from imported concentrate, was planned for startup in 1982 with full-capacity production by 1985. Work continued on the Caraíba Metais S/A in Bahia, a $775 million mine, smelter, and refinery complex planned for startup in 1981 with a capacity of 100,000 tons per year of refined copper.

Gold.—According to DNPM, the 4-year downtrend in gold production was reversed in 1977, but production was less than the 1972 high of 231,000 troy ounces. Of total production, 30% came from "garimpeiros," numerous independent prospectors operating principally in the Amazon region. Data published by Consolidated Gold Fields Ltd. show that Brazil produced 12,900 kilograms or 415,000 troy ounces of gold in 1977 and became the largest producer in Latin America. This figure includes an estimate of output by the garimpeiros not registered through sales at the Government agencies. The only industrialized mine operating was that of Mineração Morro Velho S/A near Belo Horizonte, Minas Gerais, which began operating in 1725 with extraction carried out continuously since 1834. In March 1975, the Anglo-American Corp. purchased a 49% interest in the Morro Velho complex.

CVRD initiated experimental mining of gold deposits in the Serra das Andorinhas in the State of Pará near the giant Carajás iron ore deposit, considered by DNPM to be one of the most important mineral discoveries of 1977.

Iron Ore.—A major event in 1977 was the startup of the $600 million project, Samarco Mineração S/A, a joint venture of S.A. Mineração Da Trinidade (SAMITRI) (50%) and Utah International Co., (49%). The SAMARCO project consisted of mining and concentrator facilities at the Germano mine site southeast of Belo Horizonte, a 396-kilometer slurry pipeline, and a pellet plant and ocean terminal at Ponta Ubu, 80 kilometers south of the port of Vitória, State of Espirito Santo. Average iron content of the Germano itabirite ore is 53% and it is concentrated up to 67.5%. Reserves of at least 150 million tons of ore minable by open pit methods have been established.

Capacity of the SAMARCO operation provides for 5 million tons per year of pellets and 2 million tons of pellet feed, although the pipeline was engineered to permit expansion to 12 million tons per year. The ocean terminal accommodates vessels up to 150,000 deadweight tons and may be expanded up to 250,000 deadweight-ton capacity. In its initial year of operation, SAMARCO exported 1.6 million tons of iron ore.

At yearend, arrangements had been finalized for CVRD, with 51% of the Carajás project, to purchase the 49% remaining equity held by United States Steel Corp. through its Brazilian subsidiary, Companhia Meridional de Mineração. CVRD reportedly intends to develop the Carajás project through Amazonia Mineração S/A at the reduced level of 5 million tons per year. The project includes construction of a 890-kilometer railroad to link the deposit to a projected port complex near Itaqui in the State of Maranháo. The Carajás deposit in the Amazon basin has an estimated 18 billion tons of high-grade iron ore containing 66% iron, the largest known single deposit of iron ore in the world. The major achievements during 1977 of CVRD, Brazil's dominant producer and exporter of iron ore, included completion of double-tracking of its 550-kilometer railroad used to haul iron ore from CVRD and other mines in the "Iron Quadrangle" to the ports of Tubarão and Vitória. Also, a new pellet plant was inaugurated at Tubarão of Cia. Italo-Brasileira de Pelotizacão (ITABRASCO), a joint venture of CVRD and the Italian Societá Finanziaria Siderurgica S.p.A. (Finsider). ITABRASCO's pellet production of 3 million tons per year will be used chiefly to supply the European market. With this addition, CVRD's total pellet capacity increased to 8 million tons. In 1977, CVRD produced 3.5 million tons of iron ore pellets, compared with 4.7 million tons in 1976.

CVRD's production of 42.8 million tons of ore in 1977 represented 52% of Brazil's total; its exports were 68% of the total. Although CVRD's iron ore sales in foreign markets decreased 17%, sales to the domestic market increased 84% to 5.9 million tons. Domestic consumption totaled 13.4 million tons for the year. CVRD signed contracts with Japanese steel plants for sale

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of iron ore amounting to $1.3 billion with deliveries scheduled to begin in 1979. At yearend, CVRD had sales commitments amounting to 609 million tons on a long-term basis, mostly in Asia and Western Europe.

At yearend, DNPM reported Brazil's total iron ore reserves at 32.4 billion tons, of which 9.9 billion tons was measured reserves.

Table 5.—Brazil: Production and exports of iron ore

Year	Production[1] (thousand metric tons)	Exports			
		Quantity (thousand metric tons)	Percent change from previous year	Value (thousands)	Average export price[2] (per metric ton)
1968	24,532	15,050	+5	$104,450	$6.94
1969	27,571	21,478	+43	147,400	6.86
1970	36,381	27,943	+30	209,600	7.50
1971	37,486	31,020	+11	237,000	7.64
1972	46,471	30,512	-2	231,708	7.59
1973	55,019	44,963	+47	362,811	8.08
1974	76,071	59,439	+32	571,159	9.74
1975	89,894	72,522	+22	920,891	12.92
1976	94,087	67,188	-7	995,473	15.15
1977	[3]82,001	[4]58,541	-13	907,247	15.51

[1]Data for years prior to 1972 cover crude or run-of-mine ore; those for 1972 and subsequent years cover beneficiated ore plus ores of direct-shipping grade.
[2]Based on CVRD price data beginning with 1973.
[3]Output of beneficiated ore was 80,935,691 tons.
[4]Destinations were Japan (33%), West Germany (19%), and France (7%).

Iron and Steel.—As a steel producer, Brazil ranked 14th worldwide and remained the leader in Latin America. The strong, uninterrupted upward trend of more than a decade continued in 1977 with a 22% increase in crude steel production to 11.2 million tons. Paralleling this favorable trend was the increase in output of ferroalloys to more than 371,000 tons, a 19% increase. The five major steel companies that produced more than one-half million tons of crude steel in 1977 are listed in the following tabulation:

Company	Output (thousand tons)	Percent change over prior year
Usinas Siderúrgicas de Minas Gerais (USIMINAS)	2,721	+16
Cia. Siderúrgica Nacional (CSN)	1,962	+44
Cia Siderúrgica Paulista (COSIPA)	1,539	+95
Cia Siderúrgica Belgo-Mineira	800	+1
Mannesmann S.A	601	+7
Total	7,623	--

Exports of steel products totaled $67 million.

Brazil also continued to decrease its dependence on imports of finished and semifinished steel products valued in 1977 at $660 million, compared with the peak year of 1974 when products valued at $1.7 billion were imported.

Since 1976, Brazil's largely Government-owned steel industry has continued to experience difficulty in obtaining adequate project financing. Private steel companies suffered from low, Government-controlled steel prices and increased costs of raw materials. Nonetheless, Brazil's three major steel makers, CSN, Usinas Siderúrgicas de Minas Gerais (USIMINAS) and Companhia Siderugica Paulista (COSIPA) proceeded with their phased development objectives. CSN, Latin America's oldest and largest steel facility, completed its phase 2 expansion up to a capacity of 2.5 million tons of crude steel per year, and proceeded with its phase 3 program to expand capacity up to 4.8 million tons by 1983. In 1977, USIMINAS was completing arrangements to finance its phase 3 expansion and shelved its plans to install a direct reduction facility. USIMINAS arranged with its Japanese associates to increase the company's authorized capital to $278 million, requiring

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additional contributions of the Japanese to maintain their 18.5% share in the operations. COSIPA expected to complete phase 2 expansion to 2.3 million tons per year in 1978 instead of in 1977.

A new company, Aço de Minas Gerais S/A (ACOMINAS), began construction in June 1977 of a $3.4 billion project in Ouro Branco, Minas Gerais, designed to produce 2.2 million tons of steel by 1981. As a result of these and other expansion plans, Brazil was expected to become self-sufficient in steel by the early 1980's. Siderúrgica Brasileria S/A (SIDERBRAS), the holding company for Brazil's Government-owned steel plants, decided to delay phase 4 expansion and was developing a coherent plan for the whole steel sector.

At yearend, plans had not been finalized on the initial output of the proposed Tubarão steel mill to be located at the port of Tubarão, Espirito Santo, the site of CVRD's massive iron ore pelletization complex. The Tubarão mill, a joint venture of CVRD, Finsider of Italy, and 14 Japanese companies led by Kawasaki, was originally programed to produce 3 million tons of slabs or semifinished steel by 1980.

Lead.—The rebound in the lead content of mined ore continued since the depressed level of 1975 but fell short of the peak year of 1972 when 29,880 tons was mined. However, output of primary lead from domestic and imported concentrate reached a record high of about 48,303 tons, an increase of 11%. Imports of lead concentrate that came entirely from the U.S increased 70% to 42,600 tons.

Lead ore was mined by two companies controlled by the Brazilian Peñarroya Group—Mineração Boquira S/A from mines in Bahia and PLUMBUM S/A from mines in the Paraná-São Paulo lead district. Other operations controlled by Peñarroya were being expanded to increase capacity for smelting and refining lead as indicated below, in metric tons:

Company	Smelter-refinery location	Current capacity	Planned capacity	Startup date
PLUMBUM S/A	Adrianopolis, São Paulo.	18,000	30,000	1981
Cia Brasileira de Chumbo (COBRAC)	Salvador, Bahia	32,000	45,000	1980
Total		50,000	75,000	--

Manganese.—DNPM reported a 47% drop in exports of manganese ore during 1977 to 571,200 tons. The value of exports declined 50% to $33 million. Industria e Comercio de Minerios S/A (ICOMI) remained the largest producer and exporter of ore. ICOMI produced 110,000 tons of pellets, a 10% increase.

As shown in the following tabulation, output has been increasing from the relatively new mining area of Urucum in the State of Mato Grosso where three companies are involved—Urucum Mineração S/A, Mineração Mato Grosso, and Sociedade Brasileira de Imóveis LTDA (SOBRAIMOVE).

State or territory	Gross production (thousand metric tons)		Percent change from 1976 to 1977
	1976	1977	
Amapá	2,113	1,634	-23
Minas Gerais	602	769	+28
Mato Grosso	50	236	+372
Bahia	73	71	-3
Goiás	34	26	-24
Espírito Santo	10	1	--
Total[1]	2,881	2,737	-5

[1]Data may not add to totals shown because of independent rounding.

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The Cia Mineira de Mineração acquired the manganese property at Conselheiro Lafaiete, Minas Gerais, from Cia Meridional de Mineração S/A, a subsidiary of United States Steel Corp. In the State of Pará, CVRD was actively investigating the economic feasibility of developing the manganese occurrence near the Carajás iron ore deposit, which is estimated at over 40 million tons of ore grading from 39% to 46% manganese.

Domestic consumption of manganese ore amounted to 137,430 tons compared with 116,370 tons consumed in 1976.[3] Combined production of ferromanganese and ferrosilicomanganese increased 25% to 204,000 tons, of which 39,330 tons was exported. Brazil's measurod manganese reserves at yearend were reported by DNPM to have increased 10% to 55.7 million tons grading 40% manganese.

Silver.—Brazil has not been a significant producer of silver. In 1977, silver was recovered mostly as a byproduct of lead in Paraná and, to a smaller extent, as a byproduct of gold in Minas Gerais. Silver output increased sharply in 1977 to about 372,000 troy ounces, but production was still significantly below the 1971 high of 627,000 troy ounces.

DNPM reported a great increase in measured reserves of silver to 6.4 million tons of ore, with 5,981,000 tons grading 0.74 troy ounce of silver per ton located in Guajará-Mirim, Rondonia, and 365,000 tons grading 1.93 troy ounces per ton in Adrianópolis, Paraná. Total silver content of the reserves was estimated at 5.24 million troy ounces.

Tin.—Brazil's production of tin ore (cassiterite) and tin metal achieved record highs in 1977. The Rondonia tin district accounted for 63% of Brazil's output of cassiterite. Imports of tin concentrate, which increased 162% in quantity and 230% in value, came from Bolivia (56%) and Singapore (38%). The amount of concentrate imported was equal to 41% of the country's production. Within the nonferrous group, refined tin was the only commodity produced by Brazil from domestic and imported concentrate, with a surplus available for export. The country's apparent consumption of tin in 1977 was 4,800 tons. Brazil exported 2,100 tons of primary tin mostly to the United States (77%) and Argentina (11%). Table 6 shows that Brazil had a smelter capacity that exceeded its domestic and export demands for metallic tin. At yearend, Brazil's measured tin reserves increased 9% with a metal content of 56,200 tons. The discovery of an important cassiterite-bearing granite was reported 40 kilometers north of São Félix do Xingu in the State of Pará. CPRM continued its study of the tin potential of the Rondonia tin district started in September 1976.

Table 6.—Brazil: Major tin smelters

(Metric tons)

Smelter	Location	Production capacity	1977 ingot production
Cia. Estanifera do Brasil S/A (CESBRA)[1]	Volta Redonda, Rio de Janeiro.	6,800	3,700
Cia. Industrial Amazonese S/A (CIA)[1]	Manaus, Amazonas.	4,800	1,100
Mamorá Mineração e Metalurgia Ltd	São Paulo	3,000	1,700
Best Metais e Soldas S.A.	São Paulo	1,200	400
Cia. Industrial Fluminense S/A (BRASCAN)	São João del Rei, Minas Gerais.	1,200	400
Bera do Brasil S/A	São Paulo	1,200	100
Total		18,200	7,400

[1]Also using imported concentrate of tin.

Source: National Association of Tin Producers.

Tungsten.—Output of scheelite concentrate increased 20% to a record high of 2,026 tons. The flat output trend was broken in April 1977, with the beginning of operations of the underground mine at Currais Novas, Rio Grande do Norte, of Mineração Tungstenio do Brasil (MTB). MTB's $7.5 million operation has a capacity of 600 tons per year of concentrate containing 73% WO_3.

The quantity of tungsten concentrate exported in 1977, valued at $15.2 million, increased 30% and was shipped primarily to Sweden (42%), the Low Countries (23%), and France (17%). Production of ferrotungsten increased to 141 tons com-

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pared with 15 tons produced in 1976, but was below the peak year of 1973 when 195 tons was produced.

The Government created an Interministerial working group in 1977 to investigate the feasibility of a tungsten metal-ferrotungsten plant to be located in Rio Grande do Norte. Brejuí Mineração e Metalurgia S/A was constructing a plant to process the tailings of Mineração Tomaz Salustino S/A, an important tungsten miner in the Currais Novos district. MTB's second shaft at its Boca de Lage mine will enable the company to double its output by early 1980's to 14,000 tons of ore per month.

Zinc.—Despite an impressive increase in mine output of zinc ore in Minas Gerais from 20,000 tons in 1969 to 458,000 tons of ore in 1977, Brazil continued to depend strongly on imports to satisfy internal demand for primary zinc. Imports of primary zinc represented 52% of the country's demand for zinc, estimated at 113,000 tons, a 12% increase over demand in 1976. Electrolytic zinc ingots came mostly from Mexico (60%) and Peru (32%).

The Cia. Mineira de Metais S/A (CMM), which operated Brazil's largest zinc smelter at Vazante, Minas Gerais, was expanding its capacity to 50,000 tons of slab zinc per year by 1978, with further expansion planned to 75,000 tons per year by 1979. Brazil's total smelter capacity by 1978 was to be 64,000 tons. Cia. Paraibuna de Metais S/A was constructing a smelter complex at Paraibuna, Minas Gerais, with initial output expected to be 26,500 tons of zinc in early 1979. Union Minière of Belgium has a 14.5% interest in this Brazilian company.

NONMETALS

DNPM reported substantial increases in the measured reserves of slate (280%), graphite (106%), phosphate rock (53%), kaolin (50%), lithium minerals (50%), limestone (25%), quartz (23%), and fluorspar (14%).

Asbestos.—Brazil imported about one-fourth of its asbestos requirements. The growth in production of crude asbestos and fiber has been impressive over the decade; output of ore was 1.5 million tons in 1977 compared with 171,500 tons in 1968; by 1977, Brazil ranked eighth worldwide and was the leading producer in Latin America. The main producer was S/A Mineração de Amianto (SAMA), whose Cana Brava mine is located at Minaçu, Goiás, 270 kilometers northwest of Brasilia. SAMA's output in 1977 totaled 90,224 tons of fiber and was planning to reach 115,000 tons by 1979. A smaller producer, Cimento Amianto S/A (PERMETEX), produced 1,570 tons of asbestos fiber at Barro Alto, Goiás.

Clays.—*Bentonite.*—Brazil's production of bentonite solely from reserves at Campina Grande in the State of Paraíba in the Northeast experienced steady growth during the past decade when output grew from 13,000 tons in 1968 to 143,000 tons in 1976. In that year, Brazil became Latin America's leading producer. However, in 1977, output declined 24%.

Kaolin.—Output of beneficiated kaolin, largely ceramic grade, increased 244% to about 260,000 tons. Kaolin was mined in 12 States and Territories of Brazil with beneficiated output mostly from São Paulo, Minas Gerais, and Amapá. Caulim da Amazonia Ltd. of the Ludwig Group began production during 1977 of a coating clay plant, located at Munguba on the west bank of Rio Jari in Pará, with a capacity of 220,000 tons per year to process the mineral from the Felipe deposit across Rio Jari. Caulim do Pará S/A continued to develop a project in the Capim area of Pará with a capacity of 288,000 tons per year.

Fertilizer Materials.—During the past decade, Brazil achieved considerable reduction in its dependence on foreign sources of fertilizer materials. Mined output of phosphate rock, for example, increased from 53,000 tons of contained P_2O_5 in 1968 to 650,000 tons in 1977. Nonetheless, during 1977 Brazil imported natural phosphate rock, manufactured phosphatic material, and nitrogenous and potassic fertilizers valued at $352 million. In early 1977, construction began on a $38 million phosphate mining project designed to extract 2.2 million tons per year of phosphate rock from reserves near Catalão in the State of Goiás. A new company, Fosfatos de Goiás S/A (FOSFAGO), is a joint venture of the Brasimet Group (51%), an affiliate of South American Consolidated Enterprises Inc. and the Williams Companies (49%). The open pit mine and concentrate plant was scheduled for completion by yearend 1978.

In February, a new subsidiary of PETROBRAS was created, Petrobras Mineração S/A (PETROMIN), to engage in mineral production and marketing, particularly of the large potassic reserves of Sergipe in the Northeast. In November, Enterprise Minière et Chimique (EMC) signed an agreement with PETROMIN under which Mines de Potasse d' Alsace (MDPA) will provide

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technical assistance and prepare a feasibility study on mining and processing methods for the potash deposits at Carmopolis in Sergipe.

Vermiculite.—Exploration interest was high as a result of international energy problems and vermiculite's special applications in the insulation industry. Output of crude vermiculite from the Paulistana area of Piauí and São Luiz dos Montes Belos in Minas Gerais increased remarkably from about 950 tons in 1976 to about 6,800 tons in 1977, making Brazil the leading producer in Latin America. Metais de Goiás S/A (METAGO), which is the Goiás State mining company, and Elf-Aquitaine of France entered into a joint venture to develop a vermiculite deposit at Catalão estimated to have reserves of 48 million tons. A facility to produce 30,000 tons per year of vermiculite concentrate was contemplated. Most of the output would go to Elf-Aquitaine plants in Europe.

MINERAL FUELS

Coal.—With coal output held relatively steady over the past decade, production of run-of-mine coal increased in 1977 by 44% to about 10 million tons, while marketable coal increased 10.2% to 3.6 million tons. Production of steam coal in Santa Catarina, Rio Grande do Sul, and Paraná has grown steadily to 2.8 million tons in 1977. Consumption of steam coal in 1977 was 1.9 million tons.

Despite a 24% increase in the output of metallurgical coal to 1 million tons, it was necessary to import 3.6 million tons of coal at a cost of $236 million. Imports represented 78% of the 4.6 million tons of coking coal consumed in Brazil in 1977 and came mostly from the United States (58%) and Poland (32%). Coke consumed by the Brazilian iron and steel industry amounted to 3.6 million tons, and charcoal consumed was 6.8 million tons. Consumption of metallurgical coal was expected to grow to 16 million tons in 1985, of which 12.8 million tons would be imported. Production of steam and metallurgical coal was projected to grow to 10.4 million tons by 1987.

The Companhia Riograndense de Mineração (CRM), owned by the State of Rio Grande do Sul, was carrying out a $50 million project to increase output from its Leão mine to 2 million tons of steam coal per year by the early 1980's. The output will be used to provide energy and feedstocks for a $400 million coal gasification plant being planned by PETROBRAS in Rio Grande do Sul. A working group of PETROBRAS completed a study of the gasification processes available, and preliminary negotiations were opened up with two Federal Republic of Germany engineering firms on licensing arrangements for a suitable process.

In addition to the coal reserves in southern Brazil, deposits have been discovered in the Amazon basin where large quantities of coal are believed to exist. However, difficult mining conditions, the absence of infrastructure, and remote location from consumption centers make the mining of Amazonian coal not feasible for the near future.

Natural Gas.—Production of natural gas increased 10%, reaching a record high of 63.8 billion cubic feet. Output has grown unevenly since 1968 when the amount produced was 34.7 billion cubic feet. Output of natural gas valued at $47 million represented only 1.6% of Brazil's total mineral output. Consumption of natural gas increased 38% during 1977, and the value of imports increased 57%. Negotiations continued between Brazil and Bolivia on the sale of gas from Bolivia's Santa Cruz gasfields and construction of the required 640-kilometer gas pipelines to the Brazilian border. At yearend, reserves of natural gas increased 16% to 1,400 billion cubic feet.

Oil Shale.—PETROBRAS continued experimental operation of its 1,000-barrel-per-day pilot plant using oil shale from the deposit of São Mateus do Sul in the State of Paraná to obtain data for a future industrial plant. In October 1975, the Government announced it would build a 53,000-barrel-per-day oil shale recovery plant at São Mateus do Sul. In 1977, the Government authorized the Superintendent for the Industrialization of Oil Shale (SIX) to proceed with the medium-term program of developing a detail project within the next 3 years for the construction of a plant at São Mateus do Sul. Geological exploration continued on the Irati oil shale formation in Paraná and on deposits in the States of Maranhão, Bahia, Ceará, and Santa Catarina.

Petroleum.—As a result of intensified exploration and development activities, PETROBRAS reported another increase in oil and gas reserves. At yearend, proven oil reserves increased 27% to 1.11 billion barrels compared with the 877 million barrels reported for 1976.

Production of crude petroleum further decreased 3.5%, continuing the downtrend

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since the peak year of 1974. As shown in table 7, the substantial increase in oil output from the continental shelf did not compensate for the decline in the onshore oilfields of the Bahia area. The average rate of production of 170,000 barrels per day required Brazil to import 82% of its crude oil needs. The quantity of crude oil imported was almost equal to that of 1976, but petroleum products decreased 20%. However, the cost of these imports increased slightly to $4.2 billion, of which reexports amounted to $130 million. The average cost of crude oil during 1977 was $12.30 per barrel compared with $11.50 in 1976. Saudi Arabia (34%) and Iraq (29%) continued as the major suppliers to Brazil of crude oil.

In response to the Government's conservation policies, consumption of automobile gasoline decreased 4% while total national consumption of petroleum products increased only 2.4% compared with the 9% increase the year before. Total apparent domestic consumption for 1977 was 952,000 barrels per day, compared with 1.2 million barrels per day projected for 1977 before the energy crisis. Consumption, which grew 50% between 1970 to 1973, grew by 16% between 1974 to 1977 as a result of conservation measures.

Table 7.—Brazil: Crude oil production by PETROBRAS[1]

(Thousand 42-gallon barrels)

Area	1975		1976		1977		Percent change from 1976 to 1977
	Production	Percent	Production	Percent	Production	Percent	
Bahia	39,973	63.7	39,489	64.7	32,614	55.5	-17
Sergipe	10,039	16.0	10,165	16.7	9,988	17.0	-1
Espirito Santo	1,692	2.7	1,534	2.5	975	1.7	-36
Alagoas	994	1.6	1.566	2.5	1,101	1.9	-30
Continental Shelf	10,070	16.0	8,272	13.6	14,008	23.9	+69
Total	62,768	100.0	61,026	100.0	58,686	100.0	-4

[1]Figures given in table 1 were reported subsequently by DNPM.

Source: PETROBRAS Annual Report 1976 and 1977.

During 1977, production began from a well in the Enchova field of the Campos basin located off the coast of Espirito Santo on the Continental Shelf. The Enchova field became Brazil's major producer at the rate of 10,080 barrels per day. The temporary production system for the Campos basin, comprising three wells in the Namorado oilfield and six wells in the Garoupa, were in the final installation phase and expected to be ready in the first quarter of 1978. Total investment costs for the permanent Campos production system were estimated at $2 billion, including the installation of 5 offshore platforms linking about 70 undersea wells to pump a projected 250,000 barrels of oil per day and 3 million cubic feet of gas per day to onshore facilities. Probable reserves in the Campos basin were estimated at 650 million barrels.

Offshore exploration in Brazil was at an alltime high. By yearend 1977, PETROBRAS had spent $1 billion in offshore exploration, drilling 250 wells to obtain additional reserves of 500 million barrels of oil and 12 billion cubic feet of gas. Two of the rigs were operating for British Petroleum and Shell. In 1977, PETROBRAS initiated strategic exploration program, a multibillion dollar effort involving the drilling of 325 offshore wildcats and stepouts to determine whether the Brazilian shelf is the long-sought source of the country's self-sufficiency in energy.

In January 1977, the first round of bidding under the new risk service contract procedure came to a close with the signing of a contract with the consortium formed by Elf-Aquitaine Bresil and AGIP S.p.A. for exploration in block 2 in the mouth of the Amazon River. In April, PETROBRAS signed its fourth service contract with a risk clause with Companhia Esso Prospecção do Brasil for block 4 in the Santos basin, 60 kilometers south of Rio de Janeiro.

Under the second round of bidding, two contracts were signed in December 1977 with BP Petroleum Development Brazil Ltd. and Pennzoil do Brasil Inc. This brought to six the number of service contracts PETROBRAS has signed with multinational oil companies in the period 1976-1977 for the exploration of the Amazon and Santos basins of the Continental Shelf.

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Alcohol Energy Program.—Production of anhydrous alcohol, primarily from the processing of sugar cane and manioc, was 500 million liters, representing 5% of the total motor vehicle fuel (excluding diesel fuel) used in Brazil during the year. Output of alcohol for 1978 was forecast at 2.6 billion liters. To meet the program's goal of a 20% mix with gasoline, 3.4 billion liters would be required by 1980. In December, PETROBRAS began experimental operation of an alcohol plant located in Curvelo, Minas Gerais, with a capacity of 60,000 liters per day.

Nuclear Energy.—By yearend, Brazil had not initiated industrial-scale mining or commercial beneficiation of uranium ore. A small pilot plant to produce uranium concentrate (yellowcake) was in operation at Poços de Caldas, Minas Gerais. The plant utilized small quantities of ore extracted from a nearby underground mine at Cerado. Construction continued on a 550-ton-per-year plant scheduled for late 1979 or early 1980. Initial consumption of U_3O_8 was projected at 15.4 tons in 1979, growing to 821 tons in 1987.[4] Empresas Nucleares Brasileiras S/A (NUCLEBRAS) was involved with an extensive exploration program for uranium throughout Brazil. Uranium reserves were officially revalued upwards several times during 1977. At yearend, DNPM reported a total of some 67,000 tons of U_3O_8, as shown in the following tabulation, compared with 26,000 tons of reserves reported in 1976.

[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Brazilian new cruzeiros (NCr$) to U.S. dollars at the rate of NCr$14.14 = US$1.00.

[3]Instituto Brasileiro de Siderúrgica. Anuario Estatístico da Industria Siderúrgica Brasileiro 1978. Rio de Janeiro, p. 104.

[4]Ministerio das Minas e Energia. Balanço Energético Nacional - 1978. Brazil, P. 72.

State and locality	Reserves (metric tons of U_3O_8)		
	Measured and indicated	Inferred	Total
Minas Gerais:			
Poços de Caldas	20,000	3,000	23,000
Iron Quadrangle	5,000	10,000	15,000
Paraná: Figueira	4,800	--	4,800
Goiás:			
Amorinópolis	2,000	3,000	5,000
Campos Belos	500	500	1,000
Ceará Itatira	--	18,000	18,000
Total	32,300	34,500	66,800

Source: DNPM, Anuario Mineral Brasileiro, 1978. P. 304.

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The Mineral Industry of Bulgaria

By Tatiana Karpinsky[1]

In 1977, Bulgaria produced copper, iron and steel, lead, zinc, coal, crude oil, natural gas, fertilizers, cement, fluorspar, kaolin, and other mineral commodities. Byproducts recovered from some metallic ores enhanced the economic value of mining in some cases. Indigenous production of coal, gas, petroleum, and iron supplied only a small part of the country's requirements.

According to Bulgarian sources, national income in 1977 increased 6.3% (planned 8.2%). Productivity of labor went up 7% (planned 8.1%) and accounted for the overall increment in national income. In 1977, Bulgaria paid special attention to the industrial application of the results of research and development as a major factor of enhancing the efficiency of production and the quality of output. The benefits derived from the application of scientific and technological advances were valued at over 700 million leva (L).[2]

Capital investments totaled L5.3 billion in 1977. About 68% was for renovation and development of existing industrial facilities, compared with 54% in 1976. In 1977, according to Bulgarian sources, gross industrial production increased 7% (planned 9.2%). Mechanical engineering, chemicals, iron and steel, and power generation accounted for 46.6% of total State industrial production, and ferrous and nonferrous metallurgy provided some 6%.

The following percentage increases were reported for 1977 production: Pig iron, 3.6; crude steel, 5.2; rolled steel, about 7; and electric energy, 7. Total coal production declined about 1%.

The total number of industrial workers and employees in State enterprises was 1,192,000 in 1976. The number of workers and employees in State mineral and energy enterprises by branch is given in the following table:[3]

Branch	Workers and employees (thousands)
Fuel industry	50.8
Ferrous metallurgy (including ore mining)	31.7
Engineering and metalworking industry	329.0
Production of electricity and steam heat and power	20.3

In 1977, the State Council issued a decree reorganizing the existing Ministry of Mechanical Engineering and Metallurgy and the Ministry of Mineral Resources, into a Ministry of Mechanical Engineering, and a Ministry of Metallurgy and Mineral Resources.

In 1977, Bulgaria participated in practically all of the major ongoing projects of the coordinated CMEA[4] plan for multilateral integration of undertakings through 1990.

In return for participation in the construction of the 500,000-ton-annual-capacity Kiyembay asbestos-dressing plant in Kazakhstan, U.S.S.R., Bulgaria is to receive some 40,000 tons of asbestos per year over a 12-year period. For participation in construction of the Mikhailov and Dnepropetrovsk ore-dressing plants in the U.S.S.R., Bulgaria is to receive 5.29 million tons of iron concentrate per year up to 1990. After completion of the Soviet Orenburg gas pipeline to the western frontier, which is to carry 28 billion cubic meters of natural gas per year westward, 15 billion cubic meters is earmarked as payment to the participants in the project. Bulgaria is to receive 2.8 billion cubic meters per year, a quantity

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to be almost doubled after 1980. In addition, Bulgaria participated in construction of the 1.08-million-ton-annual-capacity Nikopolsk and Ermakovsk ferroalloy plants, as well as in the construction of the 750-kilovolts Vinnitsa-Albertirsa long-distance powerline (280 kilometers) linking the Ukraine with Hungary and supplying more power to the Mir (Peace) Grid.[5]

Dunaitrans, a Bulgarian-Soviet company for the joint operation of river vessels on the Danube, was established early in 1977. In the first year of its existence, the ships of Dunaitrans have transported some 6 million tons of freight between Bulgaria and the U.S.S.R.[6]

Government Policies and Programs.—Bulgaria's national income is expected to grow 6.8% and labor productivity 6.7% in 1978. Industrial output is to exceed last year's level by 7.7%. The State budget provides for an increase in capital investment during the year to L5,950 million. About two-thirds of the investment in production is allocated to the modernization and expansion of enterprises already in operation.

Output of the machine-building industry is to increase 13.7%, the chemical industry 11.1%, electric power about 10.5%, coal 11%, and steel 6.2%. The share of machine-building, the chemical industry, ferrous metallurgy, and power in foreign trade is to increase to 43.2% of the total volume of industry trade, compared with 41.3% in 1977.

PRODUCTION

Production of coal in Bulgaria, mainly lignite and brown coal, was 25.2 million tons in 1977. About 75% of this coal production was surface-mined and 25% deep-mined. The long-term plan, up to 1990, anticipates a 2.5-fold increase in production. Hard coal production will increase considerably after development, underway in 1977, of mines in the Dobrudja deposits. The year 1977 marked a new step in the expansion and modernization of the various copper and polymetallic mines and processing plants. Estimated mine output of copper (metal content) was about 57,000 tons in 1977, enough to meet national demand and to supply some exports of copper products. Production of copper is to rise at the end of the 5-year plan period (1976-80). Planned development of new deposits of copper include expansion of open pit mining from about 70% in 1977 to 80% to 85% in 1990. Bulgaria produced enough lead and zinc in 1977 to supply internal requirements and a modest export demand.

Crude steel production in 1977 amounted to 2.6 million tons, an increase of 5.2% over that of 1976. The share of electric furnace steel increased, while the share of open-hearth steel declined. Reconstruction of the steel plant at Pernik to a facility for production of quality steels continued in 1977. Expansion of the Kremikovtsi integrated iron and steel plant also continued in 1977. The main contractor for renovation of the Kremikovtsi plant was the Skoda-Plzen enterprise of Czechoslovakia.

Construction of the aluminum-rolling mill at Shuman continued in 1977. Production there is expected to be increased considerably by the end of 1980.

Bulgaria also mined small quantities of molybdenum and manganese. In 1977, natural gas was also produced in small quantities. Development plans, however, were based on a rapid increase in gas deliveries from the U.S.S.R. The small production of crude oil in Bulgaria in 1977 was of no practical significance since 90% of the national requirements came from the U.S.S.R.

Among nonmetals, Bulgaria continued to develop production of cement, fluorspar, kaolin and other clays, and building materials. Deposits of hard white and gray marble were discovered in the Kurdzhali District in southern Bulgaria. It was expected that 1978 exports of marble and slate are to show a threefold rise over 1977.

Table 1.—Bulgaria: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Cadmium, smelter output[e]	220	220	200
Copper:			
Mine output, metal content	55,000	57,000	57,000

See footnotes at end of table.

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Table 1.—Bulgaria: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS —Continued			
Copper —Continued			
Smelter, primary and secondary	60,000	57,000	57,000
Refined, primary and secondary	52,000	55,000	58,000
Iron and steel:			
Iron ore and concentrate:			
Gross weight thousand tons	2,337	2,316	2,270
Iron content do	775	748	707
Iron concentrates do	989	1,068	1,055
Pig iron do	[r]1,509	1,558	1,614
Ferroalloys, electric furnace, all types do	51	55	50
Crude steel do	2,265	2,460	2,589
Semimanufactures, rolled do	2,495	2,756	2,931
Lead:			
Mine output, metal content	108,000	110,000	117,000
Smelter, primary and secondary	110,000	112,000	112,000
Manganese ore:			
Gross weight	35,000	40,000	40,000
Manganese content	10,000	11,200	11,400
Molybdenum, mine output, metal content	140	140	150
Silver, mine output, metal content[e] thousand troy ounces	800	900	840
Zinc:			
Mine output, metal content	[r]83,000	85,500	87,000
Smelter, primary and secondary	[r]80,000	92,500	90,000
NONMETALS			
Asbestos	700	300	500
Cement, hydraulic thousand tons	4,358	4,362	4,665
Clays, kaolin	203,000	194,000	194,000
Fertilizer materials, manufactured:			
Nitrogenous:			
Gross weight thousand tons	1,820	1,795	1,923
Nitrogen content do	672	663	705
Phosphatic:			
Gross weight do	760	734	848
Phosphorous pentoxide content do	246	242	279
Ammonia	[r]984,648	920,402	995,015
Gypsum and anhydrite:			
Crude	236	232	295
Calcined	40	40	57
Lime (quicklime) thousand tons	[r]1,590	1,599	1,725
Pyrite, gross weight[e]	[r]425,000	[r]636,000	693,000
Salt, all types	[r]89,000	75,000	87,000
Sodium and potassium compounds, n.e.s.:			
Caustic soda thousand tons	88	90	100
Sodium carbonate, calcined do	1,009	1,045	1,218
Sulfur:			
From pyrite	[r]170,000	280,000	305,000
Byproduct, all sources	[r]77,000	60,000	65,000
Total	247,000	340,000	370,000
MINERAL FUELS AND RELATED MATERIALS			
Coal (marketable):			
Anthracite thousand tons	118	99	103
Bituminous do	212	196	185
Brown do	6,455	5,850	5,748
Lignite do	21,060	19,334	19,139
Total do	27,845	25,479	25,175
Coke do	1,364	1,408	1,446
Natural gas, marketed production million cubic feet	[r]3,920	1,314	1,365
Petroleum:			
Crude oil:			
As reported thousand tons	122	117	129
Converted thousand 42-gallon barrels	891	854	942
Refinery products:			
Gasoline do	14,195	14,280	[e]14,500
Kerosine do	1,279	1,317	[e]1,500
Distillate fuel oil do	22,007	22,753	[e]23,000
Residual fuel oil do	33,167	33,899	[e]35,000
Lubricants do	560	595	[e]600
Liquefied petroleum gas do	464	545	[e]500

See footnotes at end of table.

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Table 1.—Bulgaria: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum —Continued			
Refinery products —Continued			
Asphalt, including natural ____thousand 42-gallon barrels ____	2,120	2,385	2,977
Total ____do____	[r]73,792	75,774	78,077

[e]Estimate. [p]Preliminary. [r]Revised.

[1]In addition to the commodities listed, bismuth, chromite, gold, platinum, palladium, tellurium, uranium, barite, fluorspar, magnesite, and a variety of crude construction materials, such as common clays, gravel, sand, dimension stone, and crushed stone are produced, but information is inadequate to make reliable estimates of output levels.

TRADE

Bulgaria's total foreign trade was valued at more than L12 billion in 1977, an increase of 13% over that of 1976. CMEA member countries accounted for about 80% of Bulgaria's foreign trade, with the U.S.S.R. alone accounting for 55.6%. Bulgaria ranked third among the Soviet Union's trading partners in 1977. Bulgarian trade with developed market economy countries increased sharply from L743 million in 1970 to L1,500 million in 1977; the Federal Republic of Germany, Italy, France, and the United Kingdom were the principal trading partners.

In 1977, Bulgaria's balance of payments and trade with the nonsocialist countries improved substantially. The trend towards improving the export structure to include more manufactured goods and less raw materials continued in 1977. The share of machinery and equipment in the total volume of exports reached 45.5%, compared with 42% in 1976. Other important export commodities were chemicals (9%), products of ferrous metallurgy (5%), and some nonferrous metals and alloys. Imports comprised primarily machinery and equipment, fuels, mineral raw materials, and metals.[7] In 1977, Soviet deliveries to Bulgaria included 11.7 million tons of crude oil, 6 million tons of coal, 3 billion cubic meters of natural gas, 0.3 million tons of pig iron, 0.5 million tons of rolled steel, and 4.1 billion kilowatt-hours of electric energy.

In the current 5-year plan period (1976-80), 40% of all equipment received from the U.S.S.R. is to be used for the electric power industry, 24% for the chemical industry, and 21% for the ferrous and nonferrous industry. Soviet deliveries of crude oil, natural gas, coal, and metal ores and concentrates will continue to play an important role in the further development of Bulgaria's economy. In 1978, the trade turnover between Bulgaria and the Soviet Union is to increase by more than 11% compared with 1977, and is to reach 5.6 billion rubles annually.[8]

Bulgaria's main interest in U.S. products continues to be centered on technology and equipment for ferrous and nonferrous metallurgy and other industries.

Table 2.—Bulgaria: Exports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal including alloys, all forms ____	8,041	7,827	Japan 2,380; United Kingdom 1,522; Yugoslavia 1,077.
Cadmium metal including alloys, all forms ____	--	12	All to Czechoslovakia.
Copper:			
Copper sulfate[2] ____	603	200	All to Greece.
Metal:			
Scrap ____	518	312	All to West Germany.
Unwrought and semimanufactures ____	2,199	2,336	West Germany 1,599; Italy 429; Poland 308.

See footnotes at end of table.

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Table 2.—Bulgaria: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Iron and steel metal:			
Scrap	143,466	126,668	Yugoslavia 79,837; Greece 27,846; Italy 18,716.
Pig iron thousand tons	26	24	Japan 11; Poland 8; Greece 5.
Ferroalloys	1,244	3,872	Switzerland 1,373; West Germany 1,075; Poland 493.
Steel, primary forms[3] thousand tons	231	326	Italy 75; West Germany 45; Belgium-Luxembourg 43.
Semimanufactures:			
Angles, shapes, sections[2] do	61	66	U.S.S.R. 23; Romania 16; Cuba 6.
Bars and rods[2] do	39	109	NA.
Heavy plates[2] do	328	458	West Germany 72; Italy 40; France 35; Austria 29.
Sheets and tinplates do	45	71	NA.
Hoop and strip do	[3]8	12	Greece 10.
Wire[2] do	5	13	NA.
Tubes, pipes, fittings[2] do	79	70	NA.
Castings and forgings do	--	13	All to Poland.
Total do	561	812	
Lead:			
Oxides	900	1,200	Japan 327; Yugoslavia 316; Spain 200.
Metal, unwrought	9,711	8,876	Italy 5,302; Yugoslavia 3,076.
Manganese ore	8,000	1,211	All to Poland.
Nickel metal including alloys:			
Scrap	324	142	All to West Germany.
Unwrought	350	159	Netherlands 73; Yugoslavia 61.
Silver metal including alloys, all forms value, thousands	$1,158	$1,998	West Germany $1,837; Belgium-Luxembourg $86.
Zinc metal including alloys:			
Scrap	103	[e]1,700	All to United Kingdom.
Unwrought[4]	21,406	19,523	Czechoslovakia 5,000; United Kingdom 4,511; France 2,581.
Other:			
Oxides, hydroxides and peroxides of metals, n.e.s	14	17	United Kingdom 12; Netherlands 5.
Base metals including alloys, all forms, n.e.s	6,944	8,141	U.S.S.R. 8,028; West Germany 71.
NONMETALS			
Barite	93,913	NA	
Cement[2] thousand tons	87	116	U.S.S.R. 30; Syria 18.
Clay and clay products:			
Crude clays, n.e.s.:			
Fuller's earth, chamotte	NA	12,702	Mainly to Poland.
Kaolin	8,667	10,896	All to Hungary.
Unspecified	11,897	11,350	Greece 5,529; Italy 4,775.
Products:			
Refractory	496	199	All to Yugoslavia.
Nonrefractory	7,587	3,060	Do.
Diamond, industrial value, thousands	$473	$87	West Germany $55; Belgium-Luxembourg $32.
Fertilizer materials:			
Nitrogenous[2]	601,934	650,197	Egypt 114,779; India 37,911.
Phosphatic	--	19,178	France 7,264; Italy 5,872; West Germany 2,402.
Ammonia	6,241	20,396	All to Greece.
Pigment, natural, crude	--	558	All to Hungary.
Sodium and potassium compounds, soda ash[2]	656,138	745,408	U.S.S.R. 424,810; Hungary 85,596; Czechoslovakia 30,865.
Stone, sand and gravel:			
Dimension stone	7,839	3,588	All to West Germany.
Sand	--	4,196	Do.
Sulfur:			
Elemental	--	2,000	All to Yugoslavia.
Sulfuric acid[2]	16,582	19,920	Romania 10,974.
MINERAL FUELS AND RELATED MATERIALS			
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	41	444	Greece 433; Yugoslavia 11.
Refinery products:			
Gasoline do	16	158	All to Greece.
Kerosine do	8	--	

See footnotes at end of table.

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Table 2.—Bulgaria: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum —Continued			
Refinery products —Continued			
Distillate fuel oil, thousand 42-gallon barrels	200	37	West Germany 16; Hungary 15.
Residual fuel oil, do.	--	286	Italy 210; Greece 76.
Lubricants, do.	53	31	Netherlands 10; United Kingdom 10.
Mineral jelly and wax, do.	7	15	Austria 9; Yugoslavia 4.
Other:			
Liquefied petroleum gas, do.	151	199	Greece 105; Yugoslavia 94.
Nonlubricating oils, do.	44	47	All to Yugoslavia.
Unspecified, do.	--	119	All to Poland.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	7,851	3,315	Austria 1,127; Spain 730; Yugoslavia 652.

[e]Estimate. NA Not available.

[1]Unless otherwise specified, data are partially or wholly compiled from the 1976 edition of the United Nations Supplement to the World Trade Annual, v. I, as well as official trade statistics of Czechoslovakia, East Germany, Hungary, Poland, and the U.S.S.R.

[2]Source: Official Bulgarian Trade Statistics.

[3]Source: Quarterly Bulletin of Steel Statistics for Europe, 1977 edition, United Nations, New York, 1977.

[4]Excludes quantities to Austria valued, in thousands at $765 in 1975 and $499 in 1976.

Table 3.—Bulgaria: Imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite	40	29	All from Hungary.
Metal including alloys:			
Unwrought	23,866	[2]1,545	Hungary 1,186; West Germany 237.
Semimanufactures	19,192	[2]6,744	West Germany 2,402; Austria 1,402; Hungary 1,385.
Chromium oxide and hydroxide	--	20	All from France.
Cobalt oxide and hydroxide	--	5	All from West Germany.
Copper:			
Ore and concentrate	3,900	12,920	Sweden 10,766; Spain 1,142.
Copper sulfate[3]	7,881	9,157	U.S.S.R. 7,357.
Metal including alloys, semimanufactures	6,761	[2]2,241	West Germany 847; Yugoslavia 827.
Iron and steel:			
Iron ore[3], thousand tons	1,918	1,638	All from U.S.S.R.
Metal:			
Pig iron[3], do.	330	336	Mainly from U.S.S.R.
Ferroalloys, do.	12	14	U.S.S.R. 13.
Steel, primary forms, do.	[r]36	178	NA.
Semimanufactures:			
Bars, rods, angles, shapes[3], do.	211	219	U.S.S.R. 90; East Germany 31; Poland 25.
Heavy and light sections[4], do.	[r]31	69	NA.
Plates and sheets[3], do.	287	224	U.S.S.R. 147; Poland 12.
Hoop and strip[3], do.	12	11	U.S.S.R. 9.
Rails and accessories[4], do.	[r]48	51	NA.
Wire[4], do.	[r]30	22	U.S.S.R. 10; Austria 3; West Germany 3.
Tubes, pipes, fittings[4], do.	[r]113	83	West Germany 18; U.S.S.R. 15; Yugoslavia 8.
Castings and forgings[4], do.	[r]19	30	NA.
Total, do.	[r]751	709	
Lead:			
Ore and concentrate	638	15,578	United States 9,133; Yugoslavia 5,917.
Oxides	31	73	All from Austria.
Manganese:			
Ore and concentrate	126	127	All from U.S.S.R.
Oxides	70	180	Greece 100; Ireland 80.
Nickel metal including alloys, all forms	600	131	West Germany 104.
Platinum-group metals including alloys, all forms value, thousands	$156	$533	France $356; Belgium-Luxembourg $95.
Silver metal including alloys, do.	--	$969	Switzerland $724; France $225.

See footnotes at end of table.

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Table 3.—Bulgaria: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Titanium oxides	968	1,305	Italy 973; West Germany 152.
Tungsten metal including alloys, all forms	8	12	United Kingdom 10.
Zinc ore and concentrate	12,867	9,196	Australia 8,392.
Other:			
Ore and concentrate	243	1,500	All from Netherlands.
Metals including alloys, all forms:			
Metalloids	680	752	All from Yugoslavia.
Base metals, n.e.s	1	482	Yugoslavia 450.
Nonferrous metals including alloys:[2]			
Unwrought	--	29,053	All from U.S.S.R.
Semimanufactures	--	12,390	Do.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	4,000	1,040	Hungary 576; Austria 271; Italy 198.
Dust and powder of precious and semiprecious stones, value, thousands	$350	$38	Mainly from Belgium-Luxembourg.
Grinding and polishing wheels and stones	1,712	464	Austria 217; Italy 198.
Boron oxide and acid	200	551	All from Italy.
Cement, thousand tons	186	184	U.S.S.R. 177; Poland 6.
Clay and clay products:			
Crude clay, n.e.s	293	962	All from United Kingdom.
Products:			
Refractory	38,676	34,627	U.S.S.R. 25,292; Poland 3,083; West Germany 2,246.
Nonrefractory	186	434	France 232; Italy 202.
Diamond, gem, not set or strung, value, thousands	--	$91	All from United Kingdom.
Diatomite and other infusorial earth	--	881	All from Iceland.
Feldspar and fluorspar	223	1,346	All from West Germany.
Fertilizer materials, crude and manufactured including apatite concentrate[3 5] thousand tons	1,070	1,188	U.S.S.R. 636; Morocco 195.
Pigments, iron oxides, processed	--	102	All from West Germany.
Precious and semiprecious stones, value, thousands	--	$104	All from Switzerland.
Pyrite	--	10,493	All from Spain.
Sodium and potassium compounds:			
Caustic soda	3,772	2,300	Italy 1,300; Spain 1,000.
Caustic potash	--	100	All from France.
Sulfur, thousand tons	56	59	Mainly from Poland.
Other:			
Crude	489	460	Greece 420.
Oxides of strontium, barium and magnesium	165	137	West Germany 75; France 62.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black[3]	25,688	19,631	U.S.S.R. 16,702; Romania 1,201; East Germany 1,161.
Coal, all grades, thousand tons	6,400	6,163	U.S.S.R. 6,083; Poland 80.
Coke[3], do	357	328	U.S.S.R. 285; Poland 23; Czechoslovakia 20.
Gas, natural, million cubic feet	41,848	78,716	All from U.S.S.R.
Petroleum:			
Crude[3], thousand 42-gallon barrels	76,843	79,750	U.S.S.R. 73,662.
Refinery products:			
Kerosine, do	18	10	Hungary 7; Yugoslavia 3.
Residual fuel oil, do	37	32	All from Greece.
Lubricants, do	54	30	Netherlands 8; Austria 6; United Kingdom 6.
Nonlubricating oils, n.e.s, do	8	2	United Kingdom 1.
Unspecified, do	--	56	All from Poland.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	7,983	7,708	U.S.S.R. 7,378; West Germany 330.

[r]Revised. NA Not available.

[1]Unless otherwise specified, data are partially or wholly compiled from the 1976 edition of the United Nations Supplement for the World Trade Annual, v. I, as well as official trade statistics of Czechoslovakia, East Germany, Hungary, Poland, and the Soviet Union.

[2]Individual commodity totals for 1976 and data on distribution by trading partners exclude figures for the U.S.S.R. which are not divided by individual metals, but rather are reported in two categories listed at the end of the metals section as "Nonferrous metals including alloys, unwrought and semimanufactures."

[3]Source: Official Bulgarian Trade Statistics.

[4]Source: Quarterly Bulletin of Steel Statistics for Europe, 1977 edition, United Nations, New York, 1977.

[5]Trade returns of the U.S.S.R. record the export of superphosphate and potassic salts to Bulgaria, which are evidently included in the total fertilizer imports listed here; Soviet superphosphate exports to Bulgaria were 191,657 metric tons in 1975 and 160,971 metric tons in 1976, and potassic salt exports were 93,101 tons in 1975 and 113,396 tons in 1976.

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COMMODITY REVIEW

METALS

Aluminum.—In 1977, construction continued on the Shuman complex, Bulgaria's first aluminum-processing complex, which is to have an annual capacity of 48,000 tons of rolled products. The raw materials for the new complex are to be supplied by the U.S.S.R. The aluminum-processing plant was designed in the Soviet Union and built with the assistance of Soviet specialists. Most of the machinery and equipment was from the U.S.S.R. In 1977, efforts were focused mainly on reaching the production capacity of the rolling mill and faster completion of the sheet, strip, and foil production shop scheduled to come onstream in 1979. Efforts were also concentrated on construction of the casting shop.[9] Construction of the aluminum complex was supervised by the Shuman Region Party Committee.

In 1975, Bulgaria and Yugoslavia signed a cooperative agreement that provided for a Bulgarian grant of long-term credit for expansion of the aluminum plant in Titograd, Yugoslavia. In return, Bulgaria is to receive 22,000 tons of aluminum ingots per year, as well as 3,000 tons of aluminum stock for which it will trade chemical and metal products over a 20-year period.

Copper.—In 1977, copper mine production (metal content) was estimated at 57,000 tons and production of electrolytic copper was estimated at 54,000 tons. Bulgarian copper requirements are supplied entirely by indigenous production.

The more important copper deposits are located in the Sredna Gora area near Panagyurishte, in the Chelopech and Elatsite region, and in the Burgas area near the Black Sea coast. In 1977, about 70% of total copper ore production came from the southern part of the Sredna Gora area where the 8-million-ton-annual-capacity Medet open pit mine is located. The balance came from the Chelopech underground mine, the Burgas, Panagyurishte, and other mines.

The Medet open pit mine and its ore-dressing plant began operations in 1964 and reached design capacity in 1972. Since then, the planned annual tonnage target was achieved each year.

During the past 6 years, however, the metal content of the ore has been below the expected level, and excavation was concentrated at the central part of the mine where the copper content was higher. As a result, the overburden removal plan was 95% fulfilled in 1974, 85% in 1975, 64.8% in 1976, and 61% in the first half of 1977. The accelerated deepening of the central area, without simultaneous enlargement of overburden removal, created instability leading to two large bench failures. In 1977, the lack of excavators, drills, dump trucks, and bulldozers, and a chronic shortage of spare parts for repairs at the Medet mine were among other problems reported.[10]

Medet has copper-molybdenum mineralization in granitic-monzonitic porphyry intrusions. The ore bodies consist of lenses and veins. The copper content of Medet's ore ranges from 0.05% to 0.6%. The main minerals are chalcopyrite, pyrite, and molybdenite. The Medet open pit mine uses a fully automated, computerized truck haulage control system.

The Chelopech mine (near Sofia) is Bulgaria's largest underground copper mine and has a capacity of 500,000 tons of ore per year. The development plan foresees the introduction of a high degree of mechanization and automation in the Chelopech mine and ore-dressing plant to increase capacity to 1.5 million tons per year.[11]

One of the largest projects in 1977 was the continuing development of an open pit copper mine at Elatsite, about 50 miles northeast of Sofia, that was begun in 1976. The mine has a design capacity of 10 million tons of ore per year. Estimated reserves at Elatsite are 250 million tons of copper ore. Recovery of the metal from the ore into concentrate is planned at 87%. Ore processing is to be computerized. Equipment for the Elatsite mine and dressing plant is to be imported from the Soviet Union.[12] By the end of 1979, when the complex is to come onstream, copper mining is to become an important branch of the economy in the Sofia region. The new technology applied to the development of the Elatsite mine is to reduce development lead time by 1 year and to eliminate 5 million cubic meters of overburden removal.[13]

The Dimiter Ganev copper fabricating plant, Bulgaria's sole enterprise that specializes in the production of nonferrous metal products, was reconstructed and expanded. In 1977, the plant was turning

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out various copper products, copper alloys, and many other nonferrous products, some of which were exported to CMEA member countries, Iran, Iraq, Morocco, Italy, and Switzerland. In 1978, production of the Dimiter Ganev plant is expected to increase about 7.5% over that of 1977.[14]

Since completion of exploration of Medet and Elatsite, another new copper deposit, Assarel, was discovered and explored. Plans include further exploration of Assarel and other new copper deposits in the Panagyurishte region.[15]

The Institute of Ore Mining and Dressing in Sofia is planning the development of a surface mine and an ore-dressing plant for a copper deposit in Vietnam using Bulgarian equipment. Bulgaria is also planning the development of a similar project in Algeria.

Iron and Steel.—Production of iron ore in Bulgaria was estimated at 2.3 million tons in 1977. Principal iron ore deposits are located at Kremikovtsi, north of Sofia, and contain relatively low-grade ores. The ore basically represents limonite (70%), siderite (18%), and hematite (12%). Iron ore is surface mined, and estimated reserves are placed at 250 million tons of ore. The Kremikovtsi iron ore also contains a number of other components (barite, lead, manganese, and others). Bulgarian imports of iron ore and concentrates amounted to 1.7 million tons in 1977, most of it from the U.S.S.R.

In 1977, production of pig iron totaled 1.6 million tons, an increase of 3.6% over that of 1976. About 311,500 tons of pig iron was imported in 1977. Crude steel production was 2.6 million tons, an increase of 5% over the level of 1976. Production of rolled steel in 1977 was 2.9 million tons, an increase of about 6% over that of 1976. Rolled steel imports in 1977 totaled 1.1 million tons and exports totaled 1.0 million tons.

Steel product imports are significant because the country, as yet, has been unable to produce the variety of rolled steel products required. Domestic production accounted for 97% of apparent rolled steel consumption in 1977.

In 1977, oxygen-converter steel accounted for about 57.2% of the steel output in Bulgaria, maintaining its share at approximately the same proportion as in 1976. Output of the open-hearth process declined, accounting for about 18.8%, and that by the electric-furnace process increased to 24%.

In 1977, reconstruction of the Kremikovtsi integrated iron and steel plant was in progress; the redesigned production lines at rolling mills are to bring the capacity of the plant up to 3.2 million tons per year.

The Lenin metallurgical plant, which was also under reconstruction in 1977, is to reach a capacity of up to 900,000 tons of rolled products per year.[16]

Lead and Zinc.—Lead-zinc ore production in Bulgaria has been about 6 million tons per year in recent years. In 1977, production of primary lead in Bulgaria was estimated at 117,000 tons and production of zinc was estimated at 87,000 tons. Bulgaria has several lead-zinc mining enterprises: Gorubso, Ustreme, Madjarovo, Ossogovo, Dimitrov, and a few others. In 1977, Gorubso continued to be the leading lead and zinc producer with estimated output of over 3 million tons of ore.

The principal mining centers of Gorubso enterprise are Madan, Rudozem, Leku, Kerdzhaly, and Zlatograd. These centers have many mines and beneficiation plants. Lead-zinc deposits in Bulgaria are principally of hydrothermal origin. The deposits are veined or stratified masses, usually containing galena, sphalerite and secondary silver, cadmium, bismuth, and other components. All lead-zinc ores are mined by underground methods.

In 1977, the U.S.S.R. and Bulgaria continued the joint development of nonferrous mining and metallurgy. During the 1976-80 period, L19.5 million are planned to be allocated in Gorubso lead-zinc enterprises for renovation and reconstruction of mines and processing plants.[17]

NONMETALS

Cement.—Bulgarian cement production for 1977 was 4.7 million tons, a 7% increase over that of 1976. Cement production in 1978 is to increase by about 1 million tons to 5.7 million tons. A new line with a capacity of 600,000 tons per year at Temelkovo is expected to start production in 1979.[18] Temelkovo and another large cement plant at Devnya are being built and equipped with Soviet assistance.

Fertilizer Materials.—Production of nitrogenous fertilizer in 1977 was 407,802 tons (in terms of nutrient content), an increase of 9.7% over that of 1976. Phosphatic fertilizer production reached 278,472 tons (P_2O_5 content), an increase of 15.3% over that of 1976. Bulgaria is self-sufficient in nitrogenous fertilizers and exported 283,000 tons (nutrient content) in 1977. The 1977 imports of

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phosphatic fertilizers and phosphate rock were 31,000 tons (P_2O_5 content) and 954,000 tons, respectively. Imports of potassium fertilizers increased from 50,000 tons (K_2O content) in 1976 to 58,000 tons in 1977.

Bulgaria is expanding its chemical plants. Productive capacity for ammonia, urea, and nitrogenous and phosphatic fertilizers is to increase 80% during the 1976-80 period, compared with 1971-75.

Development plans foresee the following production of fertilizers in 1980: Ammonia, 1.5 million tons; nitrogenous fertilizers, 716,000 tons; urea, 500,000 tons; and phosphatic fertilizers, 450,000 tons. Fertilizer production in Bulgaria is centered at Devnya, Dimitrovgrad, Stara Zagora, Varna, and Vratsa.

The Devnya complex, situated near Varna, has four production units specializing in many products that include fertilizers. The plant for mineral fertilizers, put into operation in 1974, produces complex fertilizers containing nitrogen, phosphorus, and potassium as well as triple superphosphate. Natural gas is used as raw material for nitrogenous fertilizers, and apatite and phosphorite are used for phosphatic fertilizers (raw materials are imported from the U.S.S.R. and elsewhere).[19] Reportedly, total fertilizer production at Devnya was about 1.2 million tons in 1977.

The Dimitrovgrad complex produces superphosphates and nitrogenous fertilizers. A new ammonia plant with an annual capacity of 450,000 tons is planned to come into production in 1978. A new 280,000-ton-annual-capacity ammonium sulfate plant was also under construction at Varna. Two new production facilities are to be built at Vratsa; a 200,000-ton-per-year urea plant and a 146,000-ton-per-year ammonia unit.

MINERAL FUELS

Total primary energy production derived from fossil fuels, hydroelectric, and nuclear power generation in Bulgaria was 15.0 million tons of standard coal equivalent (SCE) in 1977, compared with 14.7 million tons in 1976.

In 1977, the share of coal (lignite, brown, and bituminous) in total primary energy production was 90%; petroleum, 1.3%; natural gas, 0.7%; hydroelectricity, 2.7%; and nuclear power, 5.3%. The total consumption of primary energy increased from 41.9 million tons of SCE in 1976 to 42.6 million tons in 1977. In 1977, coal provided about 47.2% of total consumption; petroleum, 41.1%; natural gas, 8%; hydroelectric energy, 0.9%; nuclear power, 1.9%; and net imports of energy, 0.9%. To meet fuel requirements, Bulgaria imported 65% of the primary energy consumption in 1977.

Total primary energy balances of Bulgaria for 1976-77 are shown in table 4.

In 1977, 29.7 billion kilowatt-hours of electric energy was produced in Bulgaria, an increase of 7% over that of 1976. The Kozloduy nuclear powerplant (880 megawatts) produced about 6 billion kilowatt-hours, accounting for about 20% of the national output in 1977. It is expected that after 1980, half of the electric power produced in Bulgaria will come from nuclear plants.

Table 4.—Bulgaria: Total primary energy balance for 1976 and 1977

(Million tons of standard coal equivalent[1])

	Total primary energy	Coal (lignite, brown, bituminous) and coke	Petroleum and refinery products	Natural gas	Hydroelectric energy	Nuclear energy	Other
1976:							
Production	14.7	13.4	0.2	0.1	0.4	0.6	--
Imports	27.3	6.5	17.4	2.9	--	--	0.5
Exports	.1	--	--	--	--	--	.1
Apparent consumption	41.9	19.9	17.6	3.0	.4	.6	.4
1977:							
Production	15.0	13.5	.2	.1	.4	.8	--
Imports	27.7	6.6	17.3	3.3	--	--	.5
Exports	.1	--	--	--	--	--	.1
Apparent consumption	42.6	20.1	17.5	3.4	.4	.8	.4

[1]1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories. Conversion factors used are: Bituminous, 1.0; lignite and brown coal, 0.5; crude oil, 1.47; petroleum products, 1.54; natural gas (per thousand cubic meters), 1.33; hydroelectric and nuclear energy (per thousand kilowatt-hours), 0.125.

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Coal.—Production of coal and lignite in 1977 was 25.2 million tons, a decrease of 1.2% from that of 1976.[20] Included in this amount were 24.9 million tons of lignite and brown coal, and 288,000 tons of bituminous and anthracite. Total coal production in 1978 is planned to reach 29.3 million tons. The plan for long-range development provides for a coal production of 27 to 28 million tons in 1980, about 46 million tons in 1985, and 56 million tons in 1990. Major anticipated changes will feature an increase in preduction of lignite, a decline in output of brown coal, and a substantial increase in production of bituminous coal after development of mines at the Dobrudja deposits.

In 1977, bituminous coal imports amounted to 2.7 million tons and imports of anthracite, about 3.5 million tons, almost all from the U.S.S.R. and Poland. Imports of coke amounted to 359,000 tons, all from the U.S.S.R.

Lignite production in Bulgaria is centered in the Maritsa-East basin and brown coal production in the Bobov Dol, Pernik, and Pirin basins. In 1977, the Maritsa-East basin surface-mined output accounted for about 58% of the total coal production in Bulgaria.[21] Reserves at Maritsa-East lignite basin are estimated at 2.9 billion tons. The lignite ranges in calorific value from 1,200 to 1,600 kilocalories per kilogram (2,200 to 2,900 Btu per pound). Development plans include the creation of a giant Maritsa-East complex that is to produce 46 million tons of coal annually by 1987. In 1990, Maritsa-East basin is expected to produce 69% of the total coal production in Bulgaria. Up to 1987-90, several new coal mines are to be put into operation in this basin.

In 1977, the first of Maritsa-East's three 210-megawatt electric power stations was put into operation, and another is to be operating by the end of 1978. The Maritsa-East complex produces the cheapest coal-fired electric power in Bulgaria. The complex consists of three operating surface mines, Troyanovo 1, 2, and 3.[22] Troyanovo 4, with a projected capacity of 6 million tons per year, is to be developed during 1976-80 and is to start production after 1981.[23] Lignite mining at Maritsa-East is highly mechanized. The mine transport system is fully mechanized and features extensive use of conveyor belts. An agreement was signed with the German Democratic Republic to supply installations for the complete mechanization of all mining at the Maritsa-East coal basin by 1982.

Brown coal and bituminous coal production in Bulgaria are still below national requirements. The 1976-80 plan calls for expansion of the Bobov Dol brown coal mine to supply the region's electric powerplants but development lagged at the new Bobino mine in that basin. The plan for 1978 calls for 2.8 million tons of brown coal production in the Bobov Dol basin.

Recently, deposits of bituminous coal have been discovered in Dobrudja but their development will start in the coming 5-year plan period (1981-85).[24] In the Dobrudja basin, coal reserves are estimated at 1.2 billion tons and are reported to have a calorific value of 7,500 to 8,000 kilocalories per kilogram. The coal beds lie at depths below 1,300 meters and are overlain by water-bearing formations.

Natural Gas.—Extraction of natural gas in Bulgaria decreased from 474 million cubic meters in 1970 to 37.2 million cubic meters in 1976. Imports of natural gas from the U.S.S.R. were about 2,500 million cubic meters in 1977.

Bulgaria's gas production comes mainly from the Chiren gasfields in the northwest. Bulgaria started receiving gas through the U.S.S.R.-Bulgaria pipeline in 1974. In 1977, 20 enterprises were receiving gas from this pipeline. The Lenin metallurgical plant at Pernik and other plants were to be connected to this gasline next. Construction of the southern branch of the trunk pipeline and expansion of gas distribution stations continued in 1977.[25] Plans were to complete the south branch in 1980. Bulgaria is to receive 2.8 billion cubic meters of gas per year from the Orenburg pipeline, starting in the fourth quarter of 1978.

Petroleum.—Crude oil production is relatively small in Bulgaria. In 1977, indigenous production of crude oil was estimated at 129,000 tons. Bulgaria's oil comes from the small oilfields in the northwestern part of the country.

In 1977, 11.7 million tons of crude oil was imported from the U.S.S.R. Additional crude oil supplies came from Iraq, Iran, and Libya.[26] Imports of crude oil in 1977 increased 8.3% compared with 1976. In 1980, imports of crude oil are expected to reach 16 million tons.

Oil comes into Bulgaria by tanker across the Black Sea. Bulgaria's total crude oil processing capacity of 15.5 million tons per year is distributed as follows: About 12 million tons at Burgas, 1 million tons at Pleven, and 2.5 million tons at Ruse. The

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Burgas petrochemical plant is the main producer of fuel oil in Bulgaria. In 1977, Burgas processed an additional 1.2 million tons of petroleum. The value of refined petroleum products produced in 1977 was about L40 million higher than in 1976.[27] The construction of a new oil refinery at Burgas was underway in 1977.[28]

On September 29, 1977, Bulgaria's Minister of the Chemical Industry and the Minister of Petroleum Refining and Petrochemical Industry of the U.S.S.R. signed a general agreement on specialization and production-sharing in petrochemicals until 1990. Extensive prospecting in Bulgaria for new oilfields, including offshore exploration in the Black Sea, will be continued in 1978-80. In January 1978, it was reported that Bulgaria will expand its participation in oil and natural gas projects in the U.S.S.R. and will be compensated for its participation by deliveries of oil and natural gas.

In 1977, the second section of the Burgas-Sofia oil trunk pipeline was commissioned. This pipeline will carry 80% of the diesel fuel that was transported previously by tankcars.

Transportation of oil to the more remote regions in northwestern and northeastern Bulgaria has been more efficient and the average distance of tankcar travel has been reduced by about 400 kilometers from a terminus in Sofia. Fuel oil could be also distributed from intermediate stations on the pipeline to the other parts of the country. The pipeline was to carry 2 million cubic meters of oil products during 1977.[29]

[1]Foreign mineral specialist, Branch of Foreign Data.

[2]Because of fluctuating exchange rates, a meaningful conversion to U.S. currency is impractical. Therefore, values are reported in Bulgarian leva (L) and are not converted. The official exchange rate in June 1977 was L1=US$1.05=0.78 Soviet rubles.

[3]Statisticheski Godishnik na Narodnata Republika Bulgaria 1977 (Statistical Yearbook of the People's Republic of Bulgaria, 1977) Sofia. 1977, p. 153.

[4]CMEA—Council for Mutual Economic Assistance—includes the following countries in 1977: Bulgaria, Cuba, Czechoslovakia, the German Democratic Republic, Hungary, Mongolia, Poland, Romania, and the U.S.S.R.

[5]Vanshna Targovia (Foreign Trade), Sofia. No. 3, 1978, pp. 2-5.

[6]Vanshna Targovia (Foreign Trade), Sofia. No. 4, 1978, p. 48.

[7]Pages 3-5 of work cited in footnote 6.

[8]Vneshnyaya Targovlya, Moscow. No. 4, 1978, pp. 12-13.

[9]Ekonomicheski Zhivot (Economic Life), Sofia. July 26, 1978, p. 15.

[10]Rudnichar (The Miner), Sofia. Sept. 29, 1977, pp. 1-2.

[11]Tsvetnye Metally (Nonferrous Metals), Moscow. No. 2, 1978, p. 68.

[12]Work cited in footnote 6.

[13]Rudododbiv (Ore Production), Sofia. No. 7, 1978, p. 15.

[14]Economic News of Bulgaria, Sofia. No. 6, 1978, p. 7.

[15]Spisanie na Bulgarskoto Geologichesko Druzhestvo (Memoirs of the Bulgarian Geological Society), Sofia. No. 1, 1976, pp. 9-16.

[16]Vanshna Targovia (Foreign Trade), Sofia. No. 11, 1977, pp. 20-23.

[17]Rudododbiv (Ore Production), Sofia. No. 11, 1977, pp. 13-15.

[18]Rabotnichesco Delo (Labor Review), Sofia. July 9, 1978, p. 1.

[19]Pages 6, 8-9 of work cited in footnote 5.

[20]Statistical News, Sofia. No. 4, 1977, p. 18.

[21]V'Glishche (Coal), Sofia. No. 2, 1978, p. 3.

[22]V'Glishche (Coal), Sofia. No. 1, 1978, pp. 6-13.

[23]Energetika (Energy), Sofia. No. 8, 1978, pp. 5-7.

[24]Rudnichar (The Miner), Sofia. Oct. 27, 1977, pp. 1-2.

[25]Rabotnichesko Delo (Labor Review), Sofia. Jan. 15, 1978, p. 6.

[26]Pages 16-17 of work cited in footnote 6.

[27]Narodna Mladezh (National Youth), Sofia. Oct. 15, 1977, p. 1.

[28]Pages 2-3 of work cited in footnote 16.

[29]Otechestven Front (Fatherland Front), Sofia. Oct. 30, 1977, p. 1

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The Mineral Industry of Burma

By Gordon L. Kinney[1]

The gross domestic product (GDP) of Burma for 1977[2] was estimated at just over $4.0 billion[3] at current prices. Revised GDP figures for 1975-76 were $3,510 million for 1975 and $3,996 million for 1976. The GDP at constant 1969 prices was $1,839 million in 1976 and estimated at $1,842 million in 1977. One encouraging sign was the taming of the chronically high inflation rate. The revised Rangoon consumer price index (1972=100) increased about 14% during the year to 256, a smaller increase than in previous years. The balance-of-payments deficit was again held to a very manageable level—$29 million (revised) in 1976 and $22 million in 1977. Exports totaled an estimated $240 million, and imports increased to an estimated $312 million during 1977.

The latest figures show that the population increased 2.2% in 1977 to 31.5 million. The total active labor force was 12.4 million, with 66,000, or 0.53%, engaged in mining activities. These miners produced about 1.7% of the net 1977 output of goods and services.

The value of the output of the mineral sector for 1976 was $69 million at current prices, a 31% increase over the 1975 figure.[4] Value figures for 1977 were not available but will probably be between the 1975 and 1976 levels at constant prices and could show a modest increase at current prices.

The overall physical output of mineral products during 1977 was only slightly greater than in 1976, but the long-term trend is one of gradual decline, primarily owing to lack of new investment and failure to bring any significant new mines into production. Although its current output is small, Burma was a mineral producer of some consequence before World War II and still is considered to have a good potential for expansion. At present, however, no foreign investment is allowed in mining. All important mining operations are conducted by the Government-owned mining corporations. Foreign participation has been limited to technical assistance and financial aid. Small-scale, family-operated mines are still privately owned, with most of the output being sold to the Government.

The major aim of the Government's mining policy at present is to modernize or reopen existing mines that were in production before World War II but are now operating at reduced production levels or have closed because of deteriorated equipment and/or a lack of investment capital.

Despite Burma's favorable mineral potential, many of the most promising areas for exploration have not been mapped or prospected in any detail because of security problems.

One bright note in the mineral industry was the continued growth of the small petroleum sector during the year. The Government continued its program to upgrade the petroleum transportation system, and these improvements were instrumental in allowing a substantial increase in domestic crude oil production. In the past few years, refinery output has been restricted mainly by outmoded transport facilities rather than by a lack of crude oil at the oilfields. The Government continued its firm policy against petroleum imports, and shortages were encountered again but to a much lesser extent than in 1976. The refineries operated essentially at capacity during 1977, and the fuel shortages are expected to continue until completion of the new Japanese-financed refinery in 1981. Fourteen new development wells were sunk at existing fields during 1977. The use of im-

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proved secondary recovery techniques and these new wells contributed to the production increase in 1977. Production should continue to climb during 1978 as the full impact of the new wells, techniques, and transport improvements is felt.

PRODUCTION

Burma's total 1977 mineral output increased slightly over that of 1976. Although gains were registered in some minerals, the overall picture was one of declining output when viewed against average production figures of the past 5 years. Only coal, antimony ore, and tungsten concentrates reflect a rising trend. For all other metallic ores, on which data are available, the output trend has been declining.

Industrial minerals again had a mixed year; feldspar, gypsum, and dolomite showed sizable drops in production, and barite, yellow ocher, and limestone recorded substantial increases.

Crude oil production rose for the fourth straight year, showing a 28% increase over that of 1976. Natural gas production, which has nearly doubled since 1974, continued climbing steadily.

The value of the production of individual minerals for 1977 was not available from official sources, making comparisons and conclusions difficult and often subject to later change. A Burmese Government report[5] stated that the value of overall mineral production for 1976 (provisional) at constant 1969 prices increased 31%. The 1977 increase, however, may be significantly less.

Table 1.—Burma: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Antimony, mine output, metal content	274	468	500
Copper:			
Mine output, metal content[e]	[r]86	[r]92	45
Matte, gross weight	191	205	99
Iron and steel:			
Crude steel[e]	[r]36,000	40,000	40,000
Semimanufactures	[e]35,000	NA	NA
Lead:			
Mine output, metal content[e]	[r]9,800	[r]7,100	8,900
Smelter:			
Refined lead	[r]2,751	3,331	4,832
Antimonial lead (18%-20% antimony)	251	187	120
Nickel:			
Mine output, metal content[e]	19	24	17
Speiss, gross weight	77	94	69
Silver, mine output thousand troy ounces	775	211	233
Tin, mine output:			
Metal content of tin concentrate	[r]274	264	114
Metal content of tin-tungsten concentrate	[r]256	243	248
Total	[r]530	507	362
Tungsten, mine output:			
Metal content of tungsten concentrate	[r]155	109	108
Metal concentrate of tin-tungsten concentrate	[r]175	167	170
Metal content of tin-tungsten-scheelite concentrate	[r]165	192	168
Total	[r]495	468	446
Zinc, mine output, metal content	[r]2,647	2,211	1,834
NONMETALS			
Barite[2]	[r]25,720	15,681	17,273
Cement, hydraulic thousand tons	[r]184	233	269
Clays:[2]			
Ball clay	4,296	5,762	4,674
Bentonite	915	955	975
Fire clay[3]	3,617	2,792	4,627
Industrial white clay	2,489	4,393	3,449
Feldspar[2]	[r]810	1,709	1,422
Graphite[2]	(4)	161	96
Gypsum[2]	39,260	45,296	33,511

See footnotes at end of table.

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Table 1.—Burma: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
NONMETALS —Continued			
Precious and semiprecious stones:[2]			
Jadeite kilograms	[r]3,949	31,387	6,532
Unspecified thousand carats	76	NA	NA
Salt thousand tons	[r]98	123	188
Sand:[2]			
Glass sand, brown	5,283	NA	NA
Glass sand, white	[r]2,711	NA	NA
Stone:[2]			
Dolomite	887	1,408	366
Limestone, crushed and broken thousand tons	[r]602	645	1,159
Quartz	386	116	73
Talc and related materials, soapstone[2]	[r]421	238	201
MINERAL FUELS AND RELATED MATERIALS			
Coal	24,588	20,931	23,926
Gas, natural:			
Gross production million cubic feet	--	--	--
Marketed production[2] do	[r]7,656	8,183	10,200
Petroleum:			
Crude thousand 42-gallon barrels	6,700	8,183	10,400
Refinery products:			
Gasoline do	1,506	1,645	1,739
Jet fuel do	166	[e]188	217
Kerosine do	1,440	1,117	1,630
Distillate fuel oil do	1,463	2,045	2,145
Residual fuel and losses do	1,489	[e]2,002	1,427
Lubricants do	[r]185	[e]163	189
Other do	[r]434	[e]556	722
Refinery fuel and losses do	307	[e]461	583
Total do	6,990	8,177	8,652

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, Burma also produces pottery clay, common sand and gravel, other varities of crude construction stone, and other varities of gem stones, but available information is inadequate to make reliable estimates of output levels.

[2]Data are for fiscal year beginning Apr. 1 of that stated.

[3]Includes fire clay powder.

[4]Revised to none.

TRADE

The mining industry usually ranks third, after agriculture and forestry products, in value of exports. Exact figures are not available at this writing, but the relative importance of the mining sector is not believed to have changed in 1977. Foreign exchange revenue for minerals constituted about 7% of Burma's total receipts. Burma normally exports all of its mineral output, particularly in the metallic sector. Most ores are exported in unprocessed form because there are no substantial smelting or refining facilities in the country except the old lead and zinc smelter associated with the Bawdwin mining operation.

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Table 2.—Burma: Exports and reexports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1976	Principal destinations, 1976
METALS		
Antimony ore and concentrate	485	Singapore 362; United Kingdom 82.
Iron and steel, semimanufactures, value	$3,489	All to United Kingdom.
Lead, metal, unwrought, refined	1,622	U.S.S.R. 769; Hong Kong 735.
Silver, unwrought, thousand troy ounces	174	All to United Kingdom.
Tin ore and concentrate	484	Malaysia 279; United Kingdom 114; Netherlands 46.
Tungsten ore and concentrate	418	West Germany 330; United States 53.
Zinc ore and concentrate	2,047	Belgium-Luxembourg 1,228; West Germany 818.
NONMETALS		
Cement	19,996	Nigeria 17,654; Saudi Arabia 2,342.
Clays:		
Clay, unspecified, value	$97	NA.
Fuller's earth, do	$18	NA.
Fertilizer materials:		
Nitrogenous	2,679	All to Malaysia.
Unspecified	2,545	Indonesia 1,652; Malaysia 893.
Gem stones, excluding diamond:		
Jade:		
Uncut, thousand troy ounces	141	Mainly to Hong Kong.
Cut but not set, thousand carats	200	Hong Kong 127; United States 36; Netherlands 20.
Ruby, do	11	Hong Kong 7; Singapore 2; Sweden 1.
Sapphire, carats	1,240	Hong Kong 1,148.
Unspecified, do	1,237	East Germany 1,231.
Limestone, flux, value	$125	All to United Kingdom.
Stone, dimension, calcareous, do	$268	All to Hong Kong.
MINERAL FUELS AND RELATED MATERIALS		
Petroleum refinery products:		
Distillate fuel oil, thousand 42-gallon barrels	727	NA.
Residual fuel oil, do	6,611	India 875.
Lubricants, do	7	NA.
Mineral jelly and wax, do	[2]205	Singapore 88; East Africa 70; Italy 42.
Other:		
Petroleum coke, do	34,570	All to Japan.
Bitumen and other residues, do	6	NA.
Total, do	42,126	

NA Not available.
[1]Data for 1975 not available.
[2]Total excludes quantity valued at $274.

Table 3.—Burma: Imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Oxide and hydroxide	2	([2])	
Metal including alloys:			
Unwrought	227	864	Mainly from France.
Semimanufactures	321	367	Hong Kong 215; U.S.S.R. 120.
Chromium oxide and hydroxide	([2])	1	All from Japan.
Copper:			
Ore and concentrate	4	--	
Copper sulfate	2	1	Mainly from United Kingdom.
Metal including alloys:			
Unwrought	7	107	All from United Kingdom.
Semimanufactures	230	184	Japan 79; West Germany 71.
Iron and steel metal, including alloys:			
Pig iron, including cast iron	1,548	15,507	North Korea 10,602; South Korea 3,037.
Steel, primary forms	2,965	28,838	South Korea 16,272; Japan 12,566.
Semimanufactures	31,294	75,983	NA.
Lead metal including alloys, all forms	16	2	Mainly from Japan.
Manganese oxide	182	166	Mainly from Japan.
Mercury, 76-pound flasks	94	10,041	Mainly from West Germany.
Nickel metal including alloys, all forms	31	3	Mainly from United Kingdom.
Tin metal including alloys, unwrought and semimanufactures	150	254	Mainly from Japan.
Titanium oxide	36	33	Mainly from West Germany.

See footnotes at end of table.

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Table 3.—Burma: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS —Continued			
Zinc:			
Oxide	68	43	People's Republic of China 20; United Kingdom 12.
Metal including alloys, all forms	308	536	Mainly from Japan.
Other:			
Ores and concentrates, n.e.s	1	--	
Oxides, hydroxides, peroxides of metals, n.e.s	201	7	Mainly from Japan.
Base metals including alloys, all forms	(2)	(2)	
NONMETALS			
Abrasives, natural, n.e.s.			
value, thousands	$69	$49	NA.
Asbestos	150	410	Mainly from South Africa.
Boric acid	--	4	Mainly from United Kingdom.
Bromine	--	(2)	
Cement	699	418,908	Mainly from West Germany.
Chalk	136	4	United Kingdom 2; United States 2.
Clays and clay products:			
Crude:			
Kaolin (china clay)	8	3	All from Japan.
Other	58	27	Sweden 14; India 10.
Products:			
Refractory			
value, thousands	$325	$23	Mainly from Austria.
Nonrefractory, do	$92	$31	Mainly from People's Republic of China.
Fertilizer materials:			
Manufactured: Phosphatic	7,497	84	All from Israel.
Ammonia	20	23	Mainly from United Kingdom.
Graphite, natural	(2)	(2)	
Gypsum, value, thousands	(2)	--	
Iodine	1	(2)	
Mica, all forms	1	(2)	
Precious and semiprecious stones, except diamond, carats	--	65,749	NA.
Salt	408	34	Mainly from United Kingdom.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	5,400	3,001	United States 1,441; West Germany 1,294.
Caustic potash, sodic and potassic peroxides	4	6	Mainly from France.
Stone, sand and gravel: Quartz and quartzite	46	10	All from United Kingdom.
Sulfur:			
Elemental	832	121	All from West Germany.
Sulfuric acid	1	17	Japan 12; United Kingdom 4.
Other nonmetals, crude	1	NA	
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	113	156	Japan 109; United Kingdom 29.
Coal and briquets: Anthracite and bituminous	151,842	232,153	India 131,532; People's Republic of China 58,663.
Coke and semicoke	NA	9,107	India 6,649; West Germany 2,456.
Hydrogen, helium, rare gases	1	--	
Petroleum:			
Crude			
thousand 42-gallon barrels	1,486	--	
Refinery products:			
Kerosine and jet fuel, do	(2)	--	
Residual fuel oil, do	16	(2)	
Lubricants, do	20	15	NA.
Other:			
Mineral jelly and wax, do	(2)	(2)	
Nonlubricating oils, do	25	--	
Petroleum asphalt and pitch, do	49	22	Mainly from Japan.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	266	--	

NA Not available.

[1]Imports for consumption only, does not include imports into bond. Data for 1976 not available.

[2]Less than 1/2 unit.

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COMMODITY REVIEW

METALS

Antimony.—Production continued to climb; antimony being one of the few minerals to show a sustained growth pattern over the last few years. Production has increased an average of 17% per year since 1973. Growth could continue for many years as geologic exploration programs underway outline the actual reserves available. At present, most antimony mines are small-scale, labor-intensive operations at rich surface outcroppings. Antimony ore is sold by individual miners to the Government's Mineral Development Corp.

Copper.—Delineation drilling of the Monywa copper deposits continued under United Nations Development Program (UNDP) auspices during 1977. No additional reserves data were released. The previously reported figures of over 60 million tons of 0.7%+ copper ore indicated that an open pit mine and processing facilities would be feasible, but little development work was underway at yearend. Apparently, the reported pilot plant was not yet operating at the deposits. The proposed West German and additional Japanese bilateral assistance for the project did not materialize. There were reports of possible Yugoslav assistance, but no details were available. This copper ore site has the attraction of being located in a secure zone and being close to the rail and river transportation system. The Government was reportedly anxious for its development to begin.[6] The plans call for an 8,000-ton-per-day mill and mining operation and a 20,000-ton-per-year smelter.

Lead and Zinc.—Production of lead and zinc concentrate increased 37% and 34%, respectively, over the 1976 figures. However, tonnages produced in 1977 were still well behind the average for the previous 5-year averages. The Ministry of Planning and Finance Report to the Legislature[7] indicated that lead and zinc exploration drilling was conducted during the year, apparently at an increased level, but no results were published. Most of the lead and zinc production continued to come from the famed Bawdwin mine in Northern Shan State, which was once one of the richest lead deposits in the world. Today production is hindered by declining ore grade and the deteriorating mine and plant facilities, and although several plans to modernize the mining and smelting complex with foreign assistance have been advanced, little investment has actually been made. The West German Government extended a 6-million-Deutsche-mark (DM) loan for equipment modernization. The major deterrent to large-scale investment is the location of the mine in an area that is increasingly threatened by armed insurgent forces. The situation also prevents further exploration of nearby areas believed to have additional rich deposits. As yet, work has not started on the new West German-financed DM50-million zinc smelter to be constructed at Pyinmana 19°44' N, 96°13' E near Eala 19°37' N, 96°13' E. This would be fed mainly from the Bawdwin mine's slag and tailings piles. For many years, the zinc content was not exploited, and the waste piles have been accumulating since 1905.

Tin and Tungsten.—Production of tin and tungsten concentrates increased considerably during 1977 after a rather poor showing in 1976. Although output returned to the level of the past 5-year average, it was still only about 10% of the pre-World War II level.[8] The potentially rich deposits along the Tennassarim coast continued to be underexploited owing to a lack of capital investment, the presence of armed insurgents, and a lack of firm Government control in the area. At present, about 75% of production comes from small-scale private mining operations which sell their production to the State. The unstable conditions permit considerable illicit tin and tungsten mining, with the output often being smuggled out of Burma through Thailand and Malaysia. Since 1975, a United Nations sponsored offshore tin exploration survey has been underway along the Tennassarim coast. Recently, a sophisticated ore-sampling drill was brought in from Singapore on a specially constructed barge. It was reported that the potential offshore mining was less likely to encounter security problems.

Modernization of the old Heinda Mine, being done with West German aid, was completed in March 1977, and the mine was reported to be operating at yearend with West German technical advisers on the scene. The mine was designed to produce about 1,000 tons of tin concentrate per year. Exploration work was underway at the nearby Hermyingy underground mine, but no significant ore production was reported.

In March 1977, the World Bank's International Development Association approved a $16 million loan to cover foreign exchange costs of developing the tin and tungsten alluvial deposits in the Heinze Basin, 280 kilometers southeast of Rangoon. Work is to include a new dredge and related facilities and a new tin and tungsten concentrating

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plant at Tavoy (14°05' N, 98°12' E). Work on the project was underway at yearend. Proved ore reserves were reported to be 32 million cubic meters of sand containing about 5,000 tons of tin.

NONMETALS

There was little new development in the industrial minerals sector in 1977. Limestone, barite, and some types of clays production increased, while feldspar declined. Limestone production rose 80% to over 1 million tons. Most of this was consumed in the manufacture of 269,000 tons of portland cement. This was the second consecutive significant annual increase in cement production. First-quarter-1977 statistics indicated a significant upward trend in brick and tile production also. A Chinese source[9] reported completion of a Kyangin cement plant, but other details were not available.

Negotiations were successfully completed in January 1977 with Asahi Glass Co. Ltd., of Japan for a sheet glass plant and production technology. The plant will be located in Bassein (16°47' N, 94°44' E) and will use locally obtained glass sands. Reported capacity of the plant will be 12,000 tons per year. The existing Syriam glassware factory planned to increase its present output by replacing two old 25-ton-per-day furnaces with two new furnaces capable of producing 50 tons per day.

MINERAL FUELS

Coal.—Burma continued to have a fuel shortage during the year. The country has few known deposits of coal, and little information was available on any plans to increase the presently trivial coal production. The main producers were still believed to be the Kalewa and Nama coal mines. Production increased in 1977 to over 23,000 tons, continuing the slow but steady increase of the last few years. There were no available data on 1977 coal imports.

Petroleum and Natural Gas.—Petroleum production was the bright spot in Burma's mineral industry. Approximately 10.4 million barrels of crude oil was produced during the year, a 27% increase over the 8.2 million barrels (revised) reported for 1976. That level of production was just about the limit of the refining capacity of Burma's two small refineries, and corresponded in tonnage to about 2% of Indonesia's oil output. Demand, however, continued to climb along with production. The Burmese Government continued its policy of no petroleum imports, and shortages continued to plague the industry, albeit on a much reduced scale for 1977. The well count and crude oil production in U.S. barrels by field for 1977, together with the 1975 and 1976 totals, are summarized in the following tabulation:

Field	Number of wells				Average yearend production (42-gallon barrels per day)
	Flowing	Pumping	Gas-lift	Total	
Mann	96	6	--	102	20,400
Yenanguang	3	151	4	158	3,600
Myanaung	13	34	4	51	2,950
Chauk	4	97	--	101	1,300
Prome	16	15	--	31	1,300
Letpando	4	--	--	4	800
Total	136	303	8	447	30,350
1976	115	261	8	379	24,994
1975	105	361	--	466	16,559

Natural gas production was 9.6 billion cubic feet (272 million cubic meters) in 1977 versus 8.5 billion cubic feet (241 million cubic meters) in 1976. Output was used in industry and in gas turbine electricity generating plants.

There was no offshore exploration activity in Burma in 1977. The four foreign operators that signed service contracts in 1974—Esso Co.; Martaban-Cities Service, Ind.; Japanese Arakan Oil Development Corp., and France's CFP (Total)—all let their offshore licenses expire following unsuccessful drilling through October 1976 within their respective concessions. Of the 17 holes drilled offshore by the four companies, none yielded commercial quantities of oil and 1 produced a small amount of natural gas. The anticipated reopening of bidding for new concessions did not take place during 1977 but may occur in the near future.

Onshore exploration and development have been exclusively by the Government's

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Myanma Oil Corp. (MOC), with no foreign firms being invited to participate. MOC conducted somewhat less exploration activity in 1977 than in previous years. The major areas of interest were the upper Chindwin Basin and the Irrawaddy Delta. A number of test wells were drilled in these areas and also in the area between Prome and the Mann oilfield. There were no reports of significant finds in 1977.

Twenty-four new development wells were sunk at existing fields during the year. Of these, 17 were at Mann oilfield, 4 at Letpando, and 3 at Yenangyaung. These new development wells and improved secondary recovery techniques accounted for the year's production increases.

In the refining sector, contracts for construction of the new 25,000-barrel-per-day refinery at the Mann oilfield were finally signed in December 1977. The signing came nearly a year after the announcement of the loan agreement between the Japan Overseas Economic Cooperation Fund and the Burmese Government. Japan's Mitsubishi Heavy Industries Ltd. will be the major contractor for the full turnkey contract, which is to be completed in 1981. The objective of the plant is to supplement Burma's needs for petroleum products and to produce raw materials for synthetic fibers and petrochemicals. The range of products will be motor fuels through JP-5. The cost, reported at Japanese yen at 29.95 billion, equates to well over $100 million depending on the exchange rate used. The remote location of the refinery in central Burma added considerably to the cost. The increased refining capacity will meet Burma's projected petroleum products needs for several years.

The crude oil transportation bottlenecks encountered in the last few years have received priority attention by the Government, and the overall situation was greatly improved by yearend 1977. The most important development was the completion of the 218-kilometer-long, 25.4-centimeters-in-diameter pipeline from the Mann oilfield to the Gwema loading point at Prome. In addition, work was begun in 1977 on a project to extend the Mann pipeline the remaining 280 kilometers directly into the Syriam refinery near Rangoon. The line is being financed by a loan from the Chase Manhattan Bank and should be finished by early 1979. Completion of the line will eliminate the slow and costly river barge transport presently used to deliver most of the crude oil to the refinery.

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[1]Physical scientist, Branch of Foreign Data.

[2]All data given for the Burmese fiscal year, which is the year beginning Apr. 1 of that stated.

[3]Where necessary, values have been converted from Burmese kyats (K) to U.S. dollars at the rate of K6.7=US$1.00. Toward yearend the exchange rate was K7.2448=US$1.00.

[4]Ministry of Planning and Finance Report to the Pyithu Hluttaw on the Financial, Economic, and Social Conditions of the Socialist Republic of the Union of Burma for 1977-78. 1977, pp. 13-15.

[5]Page 75 of work cited in footnote 4.

[6]U.S. Embassy, Rangoon, Burma. Industrial Outlook Report: Minerals. State Department Airgram A-045, May 19, 1978, pp. 1-5.

[7]Page 81 of work cited in footnote 6.

[8]Work cited in footnote 6.

[9]New China News Agency (Peking). 1531 GMT, Apr. 1, 1978.

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The Mineral Industry of Canada[1]

By Walter C. Woodmansee[2]

The Canadian nonfuel mineral industry continued its gradual, sporadic recovery from the recession that prevailed during 1974-75. Prices were higher and demand was improved for some minerals but remained weak for others. Among those mineral commodities evidencing improved markets were aluminum, rolled steel, molybdenum, lead, gold, silver, and potash. Production was curtailed in several sectors of the industry. Employment was down, and some labor layoffs were necessary. The financial positions of some companies were impaired by low production, large inventory carrying charges, and rising costs.[3]

In the fuel sector, prices and markets for oil and gas, coal, and uranium remained strong. Exploration activity was intensive, particularly for natural gas and uranium.

PRODUCTION

According to preliminary estimates of the Department of Energy, Mines and Resources and Statistics Canada, the total value of mineral raw materials production reached $17.1 billion[4 5] in 1977, compared with $14.5 billion in 1976, making it the 20th consecutive year that the total mineral output value has continued an upward trend. This production was 9% of the gross national product (GNP) estimated at $197.5 billion for the year. Mineral fuels, principally crude oil and natural gas, accounted for $9.4 billion; metals, $5.3 billion; and nonmetals, including construction materials, $2.4 billion. The oil and gas industry alone accounted for 51% of the total mineral output value for the year. The most important nonfuel mineral products in terms of value were iron ore, nickel, copper, zinc, asbestos, potash, and cement.

Value of mineral output increased in each of the 10 provinces and the Yukon and Northwest Territories. The Province of Alberta was the leader by far because of its oil and gas output. Production values of the provinces and territories follow:

Province or territory	Value, billions
Alberta	$8.0
Ontario	2.5
British Columbia	1.8
Quebec	1.5
Saskatchewan	1.0
Newfoundland-Labrador	.8
Manitoba	.5
New Brunswick	.3
Northwest Territories	.3
Nova Scotia	.2
Yukon Territory	.2
Prince Edward Island	(1)
Total	17.1

[1]Less than 1/2 unit.

In 1977, Canada ranked first in world production of mine nickel and mine zinc; second in output of molybdenum, uranium, asbestos, potash, and elemental sulfur; third in output of gold, platinum-group metals, silver, titanium concentrate, and gypsum; fourth in output of primary aluminum, mine copper, and mine lead; and fifth in output of iron ore.

In January, there were 335 nonfuel mining operations throughout the country. In

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metal mining, there were 107 underground mines, 39 open pits, 8 combination underground and open pit operations, 1 surface tailings operation, and 53 placer gold operations. In nonmetal mining, including construction materials, there were 18 underground mines, 102 open pits, and 7 solution-mining operations. There were 17 mine closures and no newly productive mines during the year.

Table 1.—Canada: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Aluminum:			
Alumina, gross weight thousand tons	1,134	490	[e]490
Metal, refined do	[r]887	633	[e]962
Antimony[e 1]	1,830	1,990	[e]1,990
Bismuth[2]	157	130	140
Cadmium[3]	1,192	1,314	1,198
Calcium kilograms	428,288	513,964	566,000
Cobalt:			
Mine output, metal content[4]	1,354	1,356	1,508
Metal[5]	[r]254	298	459
Columbium and tantalum:			
Columbium concentrate (pyrochlore), Cb_2O_5 content	1,662	1,499	2,540
Tantalum concentrate, Ta_2O_5 content	179	130	145
Copper:			
Mine output, recoverable metal content[6]	733,826	730,930	780,634
Blister and anode	496,300	488,594	500,274
Refined	529,199	510,469	508,767
Gold thousand troy ounces	1,654	1,692	1,717
Iron and steel:			
Iron ore, gross weight thousand tons	46,868	58,555	56,310
Metal:			
Pig iron do	9,150	9,801	7,282
Ferroalloys do	160	225	[e]250
Crude steel do	[r]12,944	13,136	10,241
Semimanufactures[7] do	9,482	9,821	[e]10,000
Lead:			
Mine output, metal content	352,502	256,324	284,119
Refined, primary	171,516	175,720	187,500
Magnesium, primary	3,826	6,092	7,580
Mercury 76-pound flasks	12,000	--	--
Molybdenum	13,027	14,619	16,431
Nickel:			
Mine output, metal content[8]	244,783	240,825	235,362
Smelter	178,000	176,400	155,700
Platinum-group metals troy ounces	399,218	416,820	469,014
Selenium, refined[9] kilograms	[r]342,391	109,649	207,000
Silver thousand troy ounces	[r]28,995	41,199	42,758
Tellurium, refined kilograms	[r]42,252	48,697	37,000
Tin, mine output, metal content	319	274	317
Titanium:			
Ilmenite, gross weight thousand tons	[r]1,825	2,115	[e]2,115
Sorel slag (70%-72% TiO_2)	[r]749,850	814,040	711,000
Tungsten, mine output, metal content	[r]1,478	2,168	1,800
Uranium (U_3O_8)	4,679	5,627	5,953
Zinc:			
Mine output, metal content thousand tons	[r]1,229	1,145	[e]1,304
Refined, primary	426,941	472,316	494,888
NONMETALS			
Asbestos thousand tons	1,056	1,536	1,542
Barite	81,356	100,266	[e]125,900
Cement, hydraulic[10] thousand tons	9,965	9,624	10,099
Clays and clay products[11] value, thousands	[r]$85,977	$97,500	$104,200
Diatomite[e]	500	500	500
Fluorspar[e]	64,000	[r]64,000	40,000
Gypsum and anhydrite thousand tons	5,719	6,002	7,039
Lime do	[r]1,602	1,850	1,879
Magnesite, dolomite, brucite value, thousands	$5,268	$4,007	$5,610
Nepheline syenite	468,427	540,121	580,000
Potash, K_2O equivalent thousand tons	[r]$5,436	5,215	5,910
Pyrite and pyrrhotite:			
Gross weight	21,120	30,754	19,000
S content[e]	10,560	15,377	10,000

See footnotes at end of table.

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Table 1.—Canada: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
NONMETALS —Continued			
Salt thousand tons	4,835	5,994	5,933
Sand and gravel do	247,155	249,159	243,851
Silica do	2,492	2,520	2,362
Sodium and potassium compounds: Sodium sulfate	472,196	460,193	416,000
Stone[12] thousand tons	89,414	87,876	89,267
Strontium minerals: Celestite[e]	25,000	12,000	--
Sulfur, elemental byproduct:			
From smelter gases thousand tons	695	705	766
From sour natural gas do	[r]6,469	6,241	6,300
From refineries do	173	200	[e]200
From tar sands do	85	100	100
Talc, soapstone, pyrophyllite	66,029	68,834	73,000
MINERAL FUELS AND RELATED MATERIALS			
Carbon black[e]	104,000	134,000	134,000
Coal:			
Bituminous and subbituminous thousand tons	21,771	22,941	25,575
Lignite do	3,549	5,154	6,040
Coke, high-temperature do	[r]5,279	5,830	5,408
Gas, natural:			
Gross million cubic feet	3,506,128	3,515,844	[e]3,515,840
Marketed do	3,089,531	3,096,510	3,160,510
Natural gas liquids:			
Gross production:			
Butane thousand 42-gallon barrels	[r]22,816	22,288	22,981
Propane do	[r]34,695	34,032	34,704
Pentanes plus do	[r]53,868	47,950	47,548
Condensate do	[r]983	1,015	1,059
Total do	[r]112,362	105,285	106,292
Production returned to formation, all types do	88	44	NA
Peat moss thousand tons	361	394	393
Petroleum:			
Crude thousand 42-gallon barrels	520,666	488,680	482,121
Refinery products:			
Gasoline:			
Aviation do	1,448	1,477	1,481
Other do	219,917	222,660	225,593
Jet fuel do	24,954	25,146	25,597
Kerosine do	25,234	27,047	26,064
Distillate fuel oil do	154,417	159,302	169,728
Residual fuel oil do	110,721	102,385	112,791
Lubricants do	3,826	4,140	4,287
Other:			
Liquefied petroleum gas do	8,321	10,514	11,360
Petrochemical feedstocks do	NA	13,097	23,497
Asphalt do	18,008	17,396	18,422
Petroleum coke do	1,192	1,358	1,269
Unspecified do	19,133	8,757	7,217
Refinery fuel and losses do	36,409	31,283	31,697
Total do	623,580	624,562	659,003

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]Metal content of antimonial lead alloys, flue dust, and dore slag.

[2]Refined metal and bullion from domestic ores plus recoverable metal content of exported concentrate.

[3]Refined metal from domestic ores plus recoverable metal content of exported ore and concentrate.

[4]Actual output not reported; figures represent total metal content of all products derived from ores of Canadian origin, including nickel oxide sinter shipped to the United Kingdom by Inco Ltd. for further processing and nickel-copper-cobalt matte shipped to Norway by Falconbridge Nickel Mines Ltd. for further processing.

[5]Actual output not reported; figures represent the output within Canada of metallic cobalt from ores of both Canadian and non-Canadian origin.

[6]Blister copper plus recoverable metal content of exported matte and concentrate.

[7]Includes shipments of ingots from primary plants for rolling elsewhere.

[8]Refined nickel plus recoverable metal content of oxide produced plus recoverable metal content of exported matte.

[9]Refinery output from all sources, including imports and secondary sources.

[10]Cement shipped and/or used by producers.

[11]Includes the value of bentonite products from common clay, stoneware clay, fire clay, and other types of clay.

[12]Crushed, building, ornamental, paving, and similar types.

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Table 2.—Canada: Value of principal mineral production, 1977[p]

Commodity	Value, millions
METALS	
Iron ore	$1,350
Nickel	1,129
Copper	1,128
Zinc	768
Gold	253
Silver	198
Lead	184
Molybdenum	138
Platinum-group metals	58
Cobalt	17
Magnesium	17
Columbium	10
Other	34
Total	5,284
NONMETALS[1]	
Asbestos	532
Potash	397
Cement	386
Sand and gravel	324
Stone	232
Clay products	98
Sulfur	88
Salt	83
Titanium dioxide	68
Lime	57
Gypsum	27
Peat	25
Sodium sulfate	20
Quartz	17
Other	34
Total	2,388
MINERAL FUELS	
Petroleum, crude	4,639
Natural gas	3,248
Natural gas byproducts	926
Coal	633
Uranium	NA
Total	9,446
Grand total	17,118

[p]Preliminary. NA Not available.
[1]Includes construction materials.

Source: Department of Energy, Mines and Resources, Ottawa.

TRADE

In 1977, exports of crude and fabricated mineral products totaled $12.3 billion, 31% of total exports of $40 billion. About 69% of these exports went to U.S. markets and 13% went to members of the European Economic Community (EEC), principally the United Kingdom.

Imports of crude and fabricated mineral products totaled $4.4 billion, 18% of total imports valued at $24 billion. Crude petroleum accounted for $3.1 billion or 70% of mineral imports. Principal sources of oil were Venezuela and Saudi Arabia. Imports of coal, valued at $589 million, were from the United States. Other major mineral imports were bauxite, alumina, and aluminum scrap ($178 million) and iron ore and iron and steel scrap ($107 million).

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Table 3.—Canada: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Alumina (excluding abrasive grades), metal content	23,986	15,944	United States 13,161; United Kingdom 1,125.
Metal:			
Scrap	42,832	51,526	United States 41,179; Japan 6,385.
Unwrought	510,354	507,967	United States 356,103; People's Republic of China 22,894.
Semimanufactures[1]	25,074	29,304	United States 11,888; Venezuela 8,771; Pakistan 3,899.
Cadmium	643	1,555	United States 1,057; United Kingdom 382.
Calcium	310	286	Mainly to United States.
Cobalt:			
Metal	659	1,039	Do.
Oxides and salts, gross weight	561	471	United Kingdom 461; Japan 10.
Columbium concentrate[2] kilograms	9,500	5,033	All to United States.
Copper:			
Ore and matte, metal content	314,518	294,714	Japan 207,655; United States 47,656.
Slag, skimmings, and sludge, metal content	102	6,831	West Germany 3,599; Belgium-Luxembourg 2,899.
Metal:			
Scrap:			
Unalloyed	16,475	16,464	United States 9,898; Republic of Korea 1,935.
Copper alloys	13,769	16,768	United States 11,467; Japan 1,493.
Unwrought, unalloyed	319,716	306,130	United Kingdom 92,854; United States 86,625.
Semimanufactures:			
Unalloyed	26,600	28,606	United States 11,520; Venezuela 3,159.
Copper alloys	8,758	11,050	Mainly to United States.
Gold:			
Ore and concentrate, metal content thousand troy ounces	210	184	Japan 92; United States 83.
Metal:			
Unalloyed do.	NA	1,787	United States 1,435; Mexico 263.
Alloyed do.	NA	67	United States 43; Trinidad and Tobago 13; Jamaica 8.
Iron and steel:			
Iron ore thousand tons	36,034	44,685	United States 24,500; Japan 5,088.
Metal:			
Scrap do.	420	1,027	United States 715.
Pig iron and related materials do.	441	385,175	United States 236,646; Netherlands 87,245.
Ferroalloys:			
Ferromanganese	1,240	9,861	Mainly to United States.
Ferrosilicon	29,101	34,709	United States 30,045.
Other	2,024	7,320	United States 6,555.
Steel ingots and other primary forms	35,499	130,149	United States 80,756; Italy 27,274.
Semimanufactures:			
Bars, rods, angles, shapes, sections	226,462	357,143	United States 246,380.
Universals, plates, sheets, strip	508,938	804,650	United States 464,525.
Rails and accessories	128,404	186,195	United States 75,874.
Wire	44,315	46,409	Mainly to United States.
Tubes, pipes, fittings	333,581	284,281	Do.
Castings and forgings, rough	157,367	214,880	Do.
Lead:			
Ore and concentrate, metal content	211,909	140,942	Japan 75,122; United States 27,909.
Metal:			
Scrap, including alloy scrap	12,117	14,910	Republic of South Africa 6,843; West Germany 3,787.
Unwrought, unalloyed	109,965	114,570	United States 38,486; United Kingdom 37,016.
Semimanufactures	6,067	4,493	Mainly to United States.
Magnesium metal	4,733	3,445	United Kingdom 1,171; United States 673.
Mercury 76-pound flasks	[3]12,891	44,415	Italy 13,172; Algeria 10,248; Yugoslavia 6,739.
Molybdenum ore and concentrate, metal content[3]	15,680	14,553	Japan 4,865.
Nickel:			
Ore, matte, and speiss, metal content	84,391	72,688	United Kingdom 37,232; Norway 26,893.
Oxide, metal content	38,527	47,957	United States 28,683.
Metal:			
Scrap	3,232	2,599	United States 1,557.
Unwrought	99,948	99,394	United States 75,269.
Semimanufactures	10,431	12,224	United States 9,952.

See footnotes at end of table.

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Table 3.—Canada: Exports and reexports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Platinum-group metals:			
Concentrates, residues, and mattes, metal content troy ounces	433,109	388,105	Mainly to United Kingdom.
Metals:			
Scrap do	21,403	31,359	United States 20,487.
Other do	83,548	65,544	United States 32,806; United Kingdom 23,817.
Selenium metal and salts, metal content kilograms	238,680	246,345	United States 144,877.
Silver:			
Ore and concentrate, metal content thousand troy ounces	15,156	14,011	United States 8,757; Japan 3,113.
Metal, refined do	24,235	30,914	Mainly to United States.
Tin ore and concentrate, metal content[3]	1,052	796	United Kingdom 499.
Titanium:[2]			
Ilmenite and ilmenite sand[4]	200	185,631	All to Australia.
Titanium slag (70% TiO_2)	192,915	184,183	All to Canada.
Uranium and thorium concentrates value, thousands	$46,256	$93,939	United States $73,105.
Zinc:			
Ore and concentrate, metal content	705,144	653,370	Belgium-Luxembourg 229,700; Japan 117,628; West Germany 111,624.
Metal:			
Scrap, dross, ash, blue powder	18,376	19,938	United States 14,213; United Kingdom 2,012.
Unwrought	247,280	352,071	United States 274,448; United Kingdom 41,809.
Semimanufactures	r1,773	4,536	Mainly to United States.
Other:			
Ores and concentrates, gross weight	254,714	300,495	Japan 94,008; West Germany 68,419; United States 58,279.
Ash and residue containing nonferrous metals	13,568	294	United States 223.
Oxides, hydroxides, and peroxides of metals	59,134	79,207	Mainly to United States.
Metals:			
Base metals including alloys, all forms	1,339	754	United States 523.
Precious metals[5] troy ounces	58,655	47,243	Cuba 40,255.
NONMETALS			
Abrasives:			
Natural	222	25	Mainly to United States.
Fused alumina, crude and grains	127,455	154,002	Do.
Silicon carbide, crude and grains	78,824	86,460	Do.
Grinding and polishing wheels and stones value, thousands	$1,020	$883	United States $786.
Asbestos:			
Crude	183	83	United Kingdom 48.
Milled fiber, all grades thousand tons	1,074	1,651	United States 613; West Germany 150.
Barite, crude	45,606	60,296	Mainly to United States.
Cement, portland thousand tons	997	921	Do.
Clays and clay products (including all refractory brick):			
Crude (including refractory clay) do	553	835	Do.
Products:[6]			
Refractory (including nonclay brick) value, thousands	$15,183	$14,314	United States $8,951.
Nonrefractory do	$1,655	$1,656	Mainly to United States.
Diamond:			
Gem carats	26,810	38,333	United States 12,269; Belgium-Luxembourg 10,817.
Industrial (including dust) do	450,054	298,534	United States 245,636.
Fertilizer materials:			
Nitrogenous thousand tons	502	638	Mainly to United States.
Potassic do	7,242	8,278	United States 6,636.
Mixed do	532	539	United States 428.
Ammonia do	116	226	Mainly to United States.
Gypsum, crude do	3,692	4,187	Do.
Lime	235,779	309,354	Do.
Nepheline syenite	356,086	416,250	Do.
Pigments, mineral, including processed iron oxides	9,824	12,763	Do.
Precious and semiprecious stones, except diamond value, thousands	$2,382	$3,586	United States $1,095.
Salt and brine do	$5,111	$9,424	Mainly to United States.
Sand and gravel thousand tons	138	416	Do.
Sodium and potassium compounds: Sodium sulfate	178,109	146,396	Do.
Stone:			
Limestone, crude, crushed, and refuse thousand tons	1,218	1,420	Do.
Quartzite do	40	53	Do.
Rough building and crude stone, n.e.s do	303	631	Do.
Sulfur:			
Crude and refined do	3,284	4,101	United States 1,115.
Sulfuric acid, including oleum do	225	350	Mainly to United States.
Talc, steatite, soapstone, pyrophyllite	6,065	21,124	Italy 12,346; Canada 7,406.
Other, crude value, thousands	$44,913	$51,824	United States $14,034.

See footnotes at end of table.

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Table 3.—Canada: Exports and reexports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
MINERAL FUELS AND RELATED MATERIALS			
Coal, bituminous ---- thousand tons	11,695	12,977	Japan 11,685.
Coke from coal	99,998	204,242	United States 103,338.
Fuel briquets of coal and coke	2,220	1,734	Mainly to United States.
Gas, natural ---- million cubic feet	949,465	954,051	Do.
Peat	263,372	296,284	Do.
Petroleum:			
Crude ---- thousand 42-gallon barrels	262,455	182,682	Do.
Refinery products:			
Gasoline ---- do	4,876	2,763	United States 1,353.
Distillate fuel oil ---- do	6,597	1,772	United States 585.
Residual fuel oil ---- do	21,111	11,388	United States 9,871.
Lubricants ---- do	16	13	United States 6.
Other:			
Liquefied petroleum gas ---- do	36,919	17,565	Mainly to United States.
Asphalt ---- do	331	233	Do.
Petroleum coke and pitch coke ---- do	980	816	United States 644.
Total ---- do	70,830	34,550	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals ---- do	284	314	United States 257.

ʳRevised. NA Not available.
[1]May include relatively minor quantities of certain shapes not normally included among semimanufactures.
[2]Partial figures, representing U.S. imports for consumption only.
[3]Includes some scrap.
[4]Largely, if not all, used in the production of heavy aggregate.
[5]Partial figures; exclude unreported quantities of scrap and sweepings valued in thousand U.S. dollars at $26,410 in 1975 and $19,587 in 1976.
[6]Partial figures; exclude unreported quantities of refractory products valued in thousand U.S. dollars at $2,709 in 1975 and $3,033 in 1976, and nonrefractory products valued in thousand U.S. dollars at $382 in 1975 and $305 in 1976.

Table 4.—Canada: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite ---- thousand tons	2,421	1,230	Guinea 523; Guyana 300.
Alumina ---- do	761	908	Australia 427; United States 294.
Metal including alloys:			
Scrap	7,011	8,936	United States 6,092.
Unwrought	ʳ18,302	22,545	United States 16,271.
Semimanufactures (including cable)	ʳ25,379	35,221	United States 31,795.
Antimony oxides	395	734	United Kingdom 614.
Chromium:			
Ore and concentrate, metal content	29,663	39,864	Philippines 21,641; United States 10,534.
Oxide and hydroxide	956	1,261	United States 1,106.
Copper:			
Ore and concentrate (including scrap), metal content	20,247	18,672	Mainly from United States.
Copper sulfate	807	1,406	Netherlands 967.
Metal:			
Unalloyed:			
Unwrought	10,908	9,122	United States 4,925; Chile 3,995.
Semimanufactures	5,435	10,067	United States 7,858.
Alloys, unwrought and semimanufactures (including cable)[1]	13,131	16,792	United States 10,915.
Iron and steel:			
Iron ore ---- thousand tons	ʳ5,340	3,329	United States 3,111.
Metal:			
Scrap ---- do	ʳ1,024	907	Mainly from United States.
Pig iron and related materials	11,941	16,705	United States 14,085.
Ferroalloys:			
Ferrochrome	41,109	21,923	Republic of South Africa 10,066; United States 6,863.
Ferromanganese (includes spiegeleisen)	35,701	25,054	Republic of South Africa 7,881; United States 6,064.
Silicomanganese	5,732	12,022	United States 4,950; Republic of South Africa 3,588.
Ferrosilicon	26,353	10,386	United States 7,992.
Ferrotungsten	45	77	Mainly from United Kingdom.
Ferrovanadium	100	105	All from United States.
Other	8,880	24,972	Dominican Republic 12,578; United States 3,226.

See footnotes at end of table.

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Table 4.—Canada: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Iron and steel: —Continued			
Metal: —Continued			
Steel, primary forms	106,572	22,348	United States 18,300.
Semimanufactures:			
Bars, rods, angles, shapes, sections:			
Wire rod	236,645	157,561	Republic of Korea 58,471; Czechoslovakia 37,029.
Other bars and rod	146,345	141,824	United States 79,557; Japan 43,435.
Angles, shapes, sections	190,655	231,098	United States 66,518; United Kingdom 42,363.
Universals, plates, sheets, strip	582,573	464,713	Japan 180,046; United States 165,781.
Rails and accessories	67,531	24,207	United States 21,952.
Wire	54,041	57,047	United Kingdom 19,043; United States 14,391.
Tubes, pipes, fittings	196,138	169,742	United States 86,430; Japan 53,941.
Castings and forgings, rough	108,826	123,392	United States 111,369.
Lead:			
Oxide	1,002	386	Mexico 166; United States 165.
Metal including alloys, unwrought and semimanufactures	2,434	3,278	United States 2,595.
Magnesium metal including alloys	8,386	1,812	United States 1,634.
Manganese:			
Ore and concentrate, metal content	69,773	118,972	Gabon 53,424; Brazil 33,054; Republic of South Africa 19,463.
Metal	5,390	6,553	Mainly from Republic of South Africa.
Mercury 76-pound flasks	2,133	1,817	Netherlands 618; United States 603.
Molybdenum: Molybdic oxide, gross weight	56	111	All from United States.
Nickel:			
Ore and concentrate (including scrap), metal content	17,894	24,566	Australia 10,362; United Kingdom 8,432; United States 5,449.
Metal including alloys:			
Unwrought	12,847	16,829	Mainly from Norway.
Semimanufactures	4,738	4,487	United States 3,398.
Platinum-group metals troy ounces	60,971	42,610	United States 28,717; Republic of South Africa 13,200.
Silver metal thousand troy ounces	13,506	1,901	United States 1,585.
Sodium metal	8,289	8,105	Mainly from United States.
Tin metal, unwrought and semimanufactures	4,680	4,429	United States 2,681; Australia 1,134.
Titanium:			
Dioxide, pure and extended	2,708	5,241	United States 3,743; United Kingdom 760.
Metal	405	439	Mainly from United States.
Tungsten ore and concentrate, metal content	1	--	
Zinc:			
Ore and concentrate (including scrap), metal content	756	3,449	United States 1,603; Peru 922.
Oxide and peroxide	1,479	1,808	United States 1,323; United Kingdom 291.
Metal:			
Blue powder	116	185	United States 161.
Unwrought	686	12,518	Netherlands 8,329; West Germany 2,031.
Semimanufactures	1,095	1,436	United States 1,229.
Zirconium metal alloys	222	181	Mainly from United States.
Other:			
Ores and concentrates (including scrap), gross weight	85,935	360,721	United States 189,444; Chile 55,356.
Oxides, hydroxides, peroxides of metals	1,479	1,808	United States 1,323; United Kingdom 290.
Base metals including alloys, all forms	1,625	2,418	United States 1,303; Norway 534.
Precious metals troy ounces	r467,189	252,847	United States 222,868.
NONMETALS			
Abrasives:			
Natural	16,094	8,131	Mainly from United States.
Grinding and polishing wheels and stones value, thousands	r$8,220	$9,021	United States $6,777.
Asbestos	5,166	6,002	Republic of South Africa 4,576.
Barite, crude	4,479	18,097	All from United States.
Cement	428,777	329,045	Mainly from United States.
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite	242,183	274,094	All from United States.
Fire clay	43,320	33,340	Mainly from United States.
Fuller's earth	1,833	571	All from United States.
Kaolin (china clay)	148,378	176,750	United States 144,182; United Kingdom 32,568.
Other (including refractory clay)	143,156	152,998	United States 133,700.
Products:			
Refractory (including nonclay brick) value, thousands	r$62,302	$53,583	United States $46,334.
Nonrefractory do	r$24,853	$28,553	Italy $7,422; United States $6,447; West Germany $3,056.

See footnotes at end of table.

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Table 4.—Canada: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Cryolite, crude	2,219	1,113	Denmark 1,057.
Diamond:			
Gem, not set or strung carats	157,978	199,538	Israel 60,810; Belgium-Luxembourg 52,621; Netherlands 25,199.
Industrial do	1,032,396	885,361	United States 509,039; Belgium-Luxembourg 161,028; Ireland 160,186.
Dust and powder do	489,830	620,926	Mainly from United States.
Diatomite	30,270	35,765	All from United States.
Fertilizer materials:			
Nitrogenous	88,383	152,752	United States 132,747.
Phosphatic:			
Phosphate rock	3,282,258	2,241,086	Mainly from United States.
Other	128,045	168,482	Do.
Potassic	44,458	45,134	All from United States.
Other, including mixed	96,983	104,730	Mainly from United States.
Fluorspar	157,222	137,310	Mexico 62,192; Spain 52,941; United States 11,009.
Gypsum	55,338	54,769	Mexico 47,788; United States 6,981.
Iodine	167	128	Japan 109; United States 19.
Lime	30,099	36,882	Mainly from United States.
Magnesite:			
Dolomite, calcined	2,239	3,062	All from United States.
Dead-burned or sintered	84,481	38,531	United States 35,760.
Other	3,081	4,096	Mainly from United States.
Mica, crude	5,111	4,696	Do.
Pigments, mineral, including processed iron oxides	5,548	5,706	West Germany 2,310; United States 2,223; United Kingdom 699.
Precious and semiprecious stones, except diamond value, thousands	r$8,733	$9,543	United States $2,798; Hong Kong $1,336.
Salt and brine	1,183,144	1,523,345	United States 1,160,692; Mexico 310,302.
Sodium carbonate (including sal soda)	141,175	189,186	Mainly from United States.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	202,716	143,541	United States 114,200; West Germany 20,305.
Caustic potash and sodic and potassic peroxides	5,961	5,394	Mainly from United States.
Sodium sulfate (Glauber's salt)	22,638	29,265	United States 12,148; United Kingdom 7,754; Belgium-Luxembourg 7,690.
Stone, sand and gravel:			
Stone:			
Dimension:			
Crude and partly worked	53,380	44,494	United States 29,724.
Worked value, thousands	r$5,811	$5,849	United States $2,841; Italy $1,557; Portugal $1,074.
Limestone thousand tons	r3,618	3,873	All from United States.
Pumice and lava	28,563	10,356	Mainly from United States.
Quartz, silex and crystallized	1,550	863	Do.
Other, including crushed and broken	86,651	514,632	Do.
Sand and gravel:			
Silica sand thousand tons	r1,151	1,474	Do.
Other do	r2,105	2,303	Do.
Sulfur:			
Elemental	14,335	15,717	All from United States.
Sulfuric acid, including oleum	154,020	39,537	Switzerland 20,208; United States 19,323.
Talc, steatite, soapstone, pyrophyllite	30,428	46,397	Mainly from United States.
Vermiculite, crude	55,617	57,022	United States 37,059; Republic of South Africa 19,963.
Other:			
Crude value, thousands	r$3,320	$3,755	United States $3,146.
Oxides and hydroxides of magnesium, strontium, barium	32,997	25,957	Mainly from United States.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s value, thousands	r$8,593	$7,707	United States $5,139; United Kingdom $2,390.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural do	r$676	$5,097	Algeria $4,261.
Carbon black	7,009	9,081	Mainly from United States.
Coal, all grades thousand tons	r16,816	16,077	All from United States.
Coke from coal do	546	287	United States 272.
Fuel briquets of coal and coke	16,636	13,252	All from United States.
Gas, natural million cubic feet	10,447	8,955	Do.
Hydrogen and other rare gases	25,319	147,367	Mainly from United States.

See footnotes at end of table.

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Table 4.—Canada: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS — Continued			
Petroleum:			
Crude ---------- thousand 42-gallon barrels	r289,422	276,446	Venezuela 102,966; Iran 59,966.
Refinery products:			
Gasoline:			
Aviation ---------- do	19	39	Netherlands Antilles 21; United States 18.
Motor ---------- do	198	44	Netherlands Antilles 38; Venezuela 4.
Kerosine ---------- do	2	8	All from Netherlands Antilles.
Jet fuel ---------- do	578	178	Venezuela 96; Netherlands 71.
Distillate fuel oil ---------- do	2,177	937	Venezuela 397; United States 299; Bahamas 201.
Residual fuel oil ---------- do	6,822	6,628	Venezuela 3,730; United States 2,398.
Lubricants (including grease) ---------- do	1,302	1,317	United States 1,048; Trinidad and Tobago 250.
Other:			
Liquefied petroleum gas ---------- do	64	80	Mainly from United States.
Naphtha ---------- do	82	438	United States 230; Venezuela 208.
Asphalt and road oils ---------- do	158	56	Mainly from United States.
Petroleum and pitch coke ---------- do	3,149	3,243	Do.
Petroleum jelly and wax ---------- do	63	71	All from United States.
Unspecified ---------- do	868	939	Mainly from United States.
Total ---------- do	15,482	13,978	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals ----------	119,442	90,051	United States 54,768; Australia 16,649;

rRevised.

[1]May include relatively minor quantities of certain shapes not normally included among semimanufactures.

COMMODITY REVIEW

METALS

Exploration continued at a high level in all of the provinces and territories. The principal metals sought were copper, lead, zinc, gold, and silver. Continuing low prices, rising production costs, and weak domestic and foreign markets posed problems for producers of several of the metals.[e] Labor strikes at aluminum smelters in Quebec caused production losses in 1976, but operations returned to normal in 1977. The copper market remained poor; high inventories developed as a result of overproduction, and cutbacks were necessary, resulting in mine closures and deferred expansions. Higher prices for gold and a lower exchange rate to the U.S. dollar increased revenues from gold sales to U.S. markets and provided additional funds to gold-mining companies experiencing mining cost problems. Although iron ore mines operated at only 72% of capacity, some companies were developing new pellet and direct-reduction capacity. The performance of the major iron and steel companies exceeded GNP growth, although that of the smaller regional producers remained at low levels. New steelmaking capacity was under development at a number of operations. Lead mine output increased about 11% over that of 1976; revenues were higher, and stocks were drawn down. For nickel, the imbalance in world supply continued; the nickel price was soft and demand was low, leading to large inventories. Both Inco Ltd. and Falconbridge Nickel Mines Ltd. ordered plant shutdowns and nickel production cutbacks at Sudbury, Ontario. Several major zinc mines returned to normal production after labor problems in 1976. Zinc mine and refinery production was higher.

NONMETALS

Substantial capital expenditures for modernization were made at asbestos mines and mills to meet environmental standards. In the cement industry, shipments were slightly above those of 1976, and new capacity was under development. Demand for Canadian gypsum was strong, particularly in the United States. Relatively weak demand for other construction raw materials, including sand and gravel and clays, reflected the relatively poor year experienced by the construction industry. Deliveries of potash were up 30% over those of 1976. Potash Corp. of Saskatchewan, the Provincial Crown company, acquired additional potash mines and planned expansions. A new potash mine was planned in New Brunswick, following an agreement concluded between

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the Provincial Government and Potash Co. of America. Canada continued as the world's largest exporter of sulfur; exports increased 20% over those of 1976.

MINERAL FUELS

Coal production exceeded that of 1976. Emphasis was on expansion of thermal coal mines to fuel the growing number of coal-fired powerplants. Slack coking coal production reflected weak world demand for steel, including that of Japan, which is Canada's principal export market for coking coal. Mine development projects providing for increased quantities of coking coal to Japan have been postponed.

Oil and gas exploration activity reached record highs. About 6.2 million meters were drilled in more than 6,000 wells, 80% of which were in natural gas exploration and development. This spurt in drilling activity was attributed to new provincial incentives. Discoveries, particularly of natural gas, were significant. Production of natural gas increased 2% over that of 1976, while output of crude oil decreased 1%. Exports of crude oil to the United States were reduced from 1976 rates, but natural gas sales to the United States were higher, owing to the provision of emergency supplies. Petroleum refinery capacity continued to grow, including completion of a major new refinery complex at Sarnia, Ontario.

Uranium exploration was widespread, covering all provinces and territories. According to the Department of Energy, Mines and Resources, 296 exploration project areas, many of which involved foreign participation, were recorded during the year. The most intensive activity was in northern Saskatchewan, where major new deposits were discovered or under development. The 1977 increase in production was attributed to expansion at existing mines and production startup at a new mine in northern Saskatchewan.

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[1]For more detailed information on the mineral industry of Canada, see the Canadian Minerals Yearbook for 1977 and the Canadian Mineral Survey for 1977, both of which were prepared by the Mineral Development Sector, Department of Energy, Mines and Resources, Ottawa. The U.S. Bureau of Mines has arranged to have these Canadian publications placed in libraries in each of the 50 States and Puerto Rico, as follows: University of Alabama, University; E. E. Rasmuson Library, University of Alaska, Fairbanks; University of Arizona, Tucson; University of Arkansas, Fayetteville; California State Library, Sacramento; A. Lakes Library, Colorado School of Mines, Golden; Wilbur Cross Library, University of Connecticut, Storrs; H. M. Morris Library, University of Delaware, Newark; Strozier Library, Florida State University, Tallahassee; P. Gilbert Memorial Library, Georgia Institute of Technology, Atlanta; University of Hawaii, Hilo; University of Idaho, Moscow; Morris Library, Southern Illinois University, Carbondale; Indiana University, Bloomington; Iowa State University of Science and Technology, Ames; Watson Library, University of Kansas, Lawrence; M. L. King Library, University of Kentucky, Lexington; University of Southwestern Louisiana, Lafayette; R. H. Fogler Library, University of Maine, Orono; Eisenhower Library, Johns Hopkins University, Baltimore, Md.; Massachusetts Institute of Technology Library, Cambridge; Michigan Technical Library, Houghton; Wilson Library, University of Minnesota, Minneapolis; University of Southern Mississippi, Hattiesburg; Rolla Library, University of Missouri, Rolla; Montana College of Mineral Science and Technology, Butte; D. L. Love Library, Nebraska Geological Survey at University of Nebraska, Lincoln; University of Nevada, Reno; University of New Hampshire, Durham; J. C. Dana Library, Rutgers University, Newark, N.J.; New Mexico Institute of Mining and Technology, Socorro; Columbia University, New York, N.Y.; D. H. Hill Library, North Carolina State University, Raleigh; Fritz Library, University of North Dakota, Grand Forks; Ohio State University, Columbus; University of Oklahoma, Norman; Multnomah County Library, Portland, Oreg.; Pennsylvania State University, University Park; University of Rhode Island, Kingston; University of South Carolina Undergraduate Library, The Horseshoe, Columbia; South Dakota School of Mines and Technology, Rapid City; Tennessee State Library and Archives, Nashville; Main Library, University of Texas, Austin; Marriott Library, University of Utah, Salt Lake City; Bailey Library, University of Vermont, Burlington; Virginia Polytechnic Institute, Blacksburg; University of Washington, Seattle; West Virginia University, Morgantown; Memorial Library, University of Wisconsin, Madison; University of Wyoming, Laramie; and University of Puerto Rico, Mayaguez.

[2]Supervisory physical scientist, Branch of Foreign Data (now retired).

[3]Kowalski, G. The Canadian Mineral Industry: Review and Outlook. Canadian Mineral Survey, 1977 (Ottawa). Department of Energy, Mines and Resources. 1977, pp. 6-13.

[4]Where necessary, values have been converted from Canadian dollars (Can$) to U.S. dollars at the rate of Can$1.06=US$1.00, the average exchange rate for the year.

[5]Does not include the value of uranium production, which is not available.

[6]Worobec, A. Mining—An Industry Facing Troubled Times. The Northern Miner, v. 63, No. 37, sec. 3, Nov. 24, 1977, pp. C-1 and C-27.

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The Mineral Industry of Chile

By George J. Coakley[1]

Chile ranked as the world's second largest producer of copper, rhenium, and iodine, third in molybdenum, and was a major world producer of iron ore, natural nitrates, silver, and vanadium in 1977. The Chilean economy showed continued signs of improvement in 1977 as the gross domestic product in constant 1976 dollars increased nearly 9% to $9.4 billion. [2] Inflation declined to 63.5%. With exports of $2.2 billion, approximately 68% of which were mineral exports, Chile showed a balance of trade deficit of $69 million for the year. Continued low world copper prices and increased demand for imports contributed to this deficit.

Trends in production followed the 1976 pattern as copper, molybdenum, and silver reached record high output levels in 1977. Weak export demand kept iron ore production down, but improvement in domestic demand led to an increase in iron and steel output. Iodine production was up, but sodium and potassium nitrate production remained at depressed levels. Coal output held constant; petroleum and natural gas decreases were attributed to the depletion of current production sites.

Chile is placing major emphasis on the exploration and development of domestic coal, petroleum, and natural gas resources. The announcement of the first major offshore oil well, "Ostion," gave significant impetus to this effort.

Newly published reserve and resource data highlighted the magnitude of Chile's copper and molybdenum reserves, representing between 20% and 30% of known world reserves of each metal.

Government Policies and Programs.—In a major action to eliminate the bureaucratic delays in processing foreign investment applications, on March 18, the Government issued Decree Law 1748 modifying the previous legislation on foreign investment. According to the new law, there is no limit on profit and capital remittances, except that the capital must remain in the country for at least 3 years before it may be repatriated; exchange for profit and capital remittances will be available under the same conditions as apply to its purchase by local importers; there is no time limit on how long a foreign investment may remain in the country; foreign investors have the same rights and obligations as local investors, except that access to local credit facilities is limited; foreign-owned companies may opt to pay profits tax either at the normal rate for local companies, or at a rate of 49.5%, which is guaranteed fixed for 10 years from the contract date; the term, interest, commission, and other charges on foreign loans associated with foreign investments must be those authorized by the Central Bank; and existing foreign investment may become subject to the provisions of the new law by applying to the corresponding authority before March 18, 1978. The Foreign Investment Committee negotiates a separate contract with each foreign investor, stipulating the 3-year period within which the investment must be implemented. The only exception to this period is mining, where it is 8 to 12 years depending on whether exploration must first be undertaken by the investor. [3]

Decree Law 1759 published on April 30, 1977, modified the mining claim holding procedure under Chile's Mining Code. The new mining law raises the cost of holding mining claims to 52 pesos or about US$2.75 per hectare, an increase of over 1,600%. If fees are unpaid, the claim may be auctioned off after 1 year or forfeited outright after 2 years. If the claim holder is not working the claim, the fee is not recoverable. However, if the claim is being worked, the fee becomes tax-deductible. Furthermore, during the first 5 years that a claim is being developed, all startup costs, including claim

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holding fees, are considered deductible from eventual profits. The new law is designed to expedite the development of the country's mineral resources and to serve as a further incentive to attract new foreign investment.[4]

Government efforts begun in 1974 to attract new foreign investment in the mineral industry of Chile bore their first major successes in 1977 as over seven foreign investment agreements were finalized, representing a potential capital inflow of over $2.4 billion.

In July a consortium of Falconbridge Nickel Mines Ltd., Superior Oil Co. of Houston, Canadian Superior Oil Ltd., and McIntyre Mines Ltd. signed a 30-year contract to undertake a $500 million development of the Quebrada Blanca copper deposit, located 75 miles north of Chuquicamata. The contract is contingent on the successful completion of a 4-year exploration and feasibility program costing up to $5 million. A 100,000—ton-per-year copper operation is envisaged. The consortium will hold a 51% share in the project, with the Government holding the remainder.

Noranda Mines Ltd. signed an agreement with the Government-owned Empresa Nacional de Minería (ENAMI) to explore, study, and, if attractive, develop the Andacollo porphyry copper deposit. Potential investment is estimated at about $450 million.

St. Joe Mining Corp. signed a $100 million agreement to examine and develop the El Indio gold, copper, and silver deposit near La Serena.

Foote Mineral Co. signed a contract agreement valued at $23 million to develop the lithium-bearing brines near Peña in the Atacama Desert. Metallgesellschaft AG has agreed to undertake the development of two lead-zinc projects near Asien each valued at around $35 million.

The Foreign Investment Committee also approved an agreement with Ataka Mitsubishi of Japan to undertake a $60 million feasibility and development project to exploit the Santa Clara iron ore deposit near Chañaral.

Late in December ENAMI sold 87% of its interest in Cia. Minera Disputada las Condes to Exxon Mineral International Inc. for an estimated $107 million. Exxon acquired Disputada's two operating mines and a smelter, but more importantly, Exxon indicated an intent to invest up to $1 billion to develop the Chilean company's large unexploited copper reserves.

PRODUCTION

Chilean copper and its major byproduct molybdenum and silver production exceeded 1976 record levels by 5% to 15% each. Smelter and refinery outputs of copper increased 4% and 7%, respectively. Iron ore production was held down in response to weak world markets and in an effort to reduce stockpiled ore levels. Iron and steel production increased to within 75% to 80% of capacity in response to increased domestic demand. Reversing previous trends, iodine production increased 16%. Continued problems in the nitrate industry were reflected in lower sodium nitrate and potassium nitrate output. Coal production remained constant as efforts continued to develop the known coal resources of the Magallanes area. Petroleum and natural gas production continued to decline; however, new offshore discoveries and the inferred potential of the offshore Straits of Magellan fields are expected to substantially boost production within the next 3 to 5 years.

Table 1.—Chile: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Copper:			
Mine output, metal content[2]	828,300	1,005,200	1,056,200
Metal:			
Smelter[3]	724,400	856,300	888,400
Refined:[4]			
Fire refined	125,300	141,700	e146,700
Electrolytic	409,900	490,300	529,300
Total	535,200	632,000	676,000

See footnotes at end of table.

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Table 1.—Chile: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS —Continued			
Gold, mine output, metal content—troy ounces	[r]128,513	129,172	112,736
Iron and steel:			
Ore and concentrates—thousand tons	11,007	10,005	7,655
Pig iron—do	417	403	432
Ferroalloys—do	19	20	[e]12
Crude steel[8]—do	490	480	547
Semimanufactures (hot-rolled)—do	284	342	382
Lead, mine output, metal content	309	1,816	789
Manganese ore and concentrate	20,016	23,639	18,002
Mercury—76-pound flasks	97	13	20
Molybdenum, mine output, metal content	9,091	10,899	10,937
Selenium—kilograms	11,819	15,041	8,297
Silver—thousand troy ounces	[r]6,236	7,342	8,447
Vanadium, mine output, metal content[e]	600	1,088	860
Zinc, mine output, metal content	3,174	5,053	3,739
NONMETALS			
Barite	[r]6,299	21,243	63,659
Borates, crude, natural	[e]915	3,432	4,248
Cement, hydraulic—thousand tons	1,014	963	1,123
Clays:			
Kaolin	59,532	66,735	50,188
Other (unspecified)	[r]57,222	44,079	73,457
Diatomite	186	330	480
Feldspar	[r]3,414	823	2,452
Fertilizer materials, crude:			
Nitrates:			
Sodium	656,250	491,415	482,110
Potassium enriched	70,460	127,565	81,160
Phosphates, guano	[r]13,518	16,107	7,017
Gem stones, lapis lazuli—kilograms	1,700	NA	NA
Gypsum:			
Crude	[r]131,659	65,079	147,404
Calcined	[r]45,494	56,843	56,447
Iodine, elemental	1,942	1,424	1,652
Pigments, natural mineral, iron oxides	[r]9,085	6,941	8,146
Pumice (includes pozzolan)	[r]88,753	98,681	158,938
Quartz:			
Common quartz	[r]130,528	158,195	80,599
Glass sand	2,268	4,995	NA
Salt, all types—thousand tons	299	428	424
Stone:			
Limestone—do	1,518	1,723	1,873
Marble	[r]494	423	1,413
Sulfate, sodium[7]	[r]35,087	40,791	44,358
Sulfur:			
Native, other than Frasch:			
Refined	4,940	16,334	4,964
Caliche	16,411	1,428	26,984
Byproduct (from industrial gases)	[r]25,985	30,079	26,055
Total	[r]47,336	47,841	58,003
Talc	[r]474	1,109	427
MINERAL FUELS AND RELATED MATERIALS			
Coal, bituminous and lignite—thousand tons	[r]1,515	1,272	1,342
Coke:			
Coke, oven—do	211	214	[e]215
Gashouse—do	5	[e]5	[e]5
Gas, natural:			
Gross production—million cubic feet	250,625	248,318	237,273
Marketed—do	128,278	141,858	133,875
Natural gas liquids:			
Condensate—thousand 42-gallon barrels	712	686	[e]600
Natural gasoline—do	984	918	[e]900
Liquefied petroleum gas—do	2,986	2,887	[e]2,700
Total—do	4,682	4,491	[e]4,200

See footnotes at end of table.

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Table 1.—Chile: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum:			
Crude thousand 42-gallon barrels	8,946	8,371	8,030
Refinery products:			
Gasoline:			
Aviation do	107	75	98
Motor do	[r]7,415	8,091	7,880
Jet fuel do	734	937	1,080
Kerosine do	2,499	2,843	2,666
Distillate fuel oil do	6,570	6,386	6,535
Residual fuel oil do	7,696	7,712	9,315
Other:			
Liquefied petroleum gas do	[r]3,690	5,286	2,506
Unspecified do	NA	NA	1,268
Refinery fuel and losses do	[r]1,829	1,251	1,233
Total do	[r]30,540	32,581	32,581

[e]Estimated. [p]Preliminary. [r]Revised. NA Not available

[1]In addition to the commodities listed, lime and pyrites are produced but available information is inadequate to make reliable estimates of output levels.

[2]Data given are the nonduplicative copper content of ores, concentrates, precipitate, metal and other copper-bearing products measured at the least stage of processing reported in available sources.

[3]Figures presented are total blister and equivalent copper output including that blister subsequently refined in Chile and copper produced by electrowinning.

[4]Figures presented are total refined copper distributed into two classes according to method of refining.

[5]Excludes castings.

[6]Revised from "none."

[7]Includes natural sodium sulfate and anhydrous sodium sulfate, coproduct of the nitrate industry.

TRADE

Chile showed a negative trade balance for the first time in 4 years, with a 1977 deficit of $69 million. The deficit reflects an increased level of imports stimulated by two tariff cuts during the year, bringing tariffs down to a nearly uniform rate of 10%. This is part of the Government's policy to promote a free market system. Copper accounted for $1.14 billion or 43% of the $2.6 billion value of all exports. In the past, copper has provided from 75% to 80% of all export earnings. The reduction is attributed, in part, to continued low copper prices and also to Government efforts to encourage the expansion of nontraditional exports. Of the 1 million tons of copper exported in 1977, 18% went to Federal Republic of Germany 16% to Brazil, 14% to the United States, and 11% to Japan.

The other major mineral export earners in 1977 were, in million dollars, iron ore-$81, nitrates-$35.5, and molybdenum and other copper byproducts-$101.6. The $378 million value of petroleum imports represented 16% of all imported goods; coal and coke imports accounted for an additional $19.8 million. Crude petroleum imports totaling 27.6 million barrels were purchased from Iran (42%), Venezuela (31%), Ecuador (20%), Gabon (3%), and Iraq (3%).

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Table 2.—Chile: Exports of copper and iron ore

(Metric tons unless otherwise specified)

Commodity and country of destination		1975	1976	1977
Copper ore and concentrate, copper content:				
Canada		--	5,700	--
Germany, Federal Republic of		15,000	22,400	32,300
Japan		54,700	57,700	65,100
Korea, Republic of		5,800	9,200	17,600
Spain		12,900	24,700	20,800
Taiwan		2,000	2,100	10,700
Other		13,400	34,400	24,500
Total		103,800	156,200	171,000
Blister copper:				
China, People's Republic of		8,000	22,900	12,000
Germany, Federal Republic of		53,000	83,200	71,300
Japan		--	9,200	10,500
Spain		15,000	18,000	18,900
United Kingdom		38,800	30,100	22,200
United States		26,500	35,600	41,800
Yugoslavia		10,500	12,700	17,500
Other		28,000	19,300	22,500
Total		179,800	231,000	216,700
Refined copper:				
Argentina		36,700	19,000	34,900
Belgium		8,400	27,200	32,300
Brazil		45,400	143,200	156,600
France		45,000	41,700	31,500
German Democratic Republic		18,000	11,000	1,400
Germany, Federal Republic of		102,700	84,700	77,500
Italy		55,700	71,300	64,400
Japan		32,100	32,200	34,700
Sweden		21,300	12,500	7,000
United Kingdom		66,100	56,000	47,200
United States		26,900	63,600	101,700
Other		45,900	32,300	28,300
Total		504,200	594,700	617,500
Iron ore, gross weight:				
Argentina	thousand tons	415	112	169
Belgium	do	--	615	200
Germany, Federal Republic of	do	--	216	--
Japan	do	8,712	7,476	6,765
United States	do	953	518	556
Total	do	10,080	8,937	7,690

COMMODITY REVIEW

METALS

Copper.—Continuing a policy of maximizing production levels, the Chilean copper industry in 1977 increased mine production 5% to a record high of 1,056,200 tons, smelter production 4% to 888,400 tons, and refinery output 7% to 676,000 tons. As shown in table 3, mine production was up at all mines except for a marginal drop at El Salvador and Disputada. Mining high-grade 2.34% copper ore during the year Codelco-Chile's Chuquicamata division accounted for 45% of all copper production. As the world's single largest copper mine, Chuquicamata mine production involved the removal of over 28.6 million tons of ore and 63 million tons of waste in 1977.

Corporación Nacional del Cobre de Chile (Codelco-Chile) reported that average production grades at Chuquicamata are expected to decline to 1.87% copper in the period 1978-82 and to 1.59% in the period 1983-86. During a comparable period, El Teniente is scheduled to maintain fairly constant ore grades, dropping only 3% from its 1977 level of 1.54%. El Salvador and Andina, however, will each decrease approximately 16% from the current head grades of 1.12% and 1.44%, respectively.

In anticipation of this trend in decreasing ore grades, Codelco-Chile is investing approximately $100 million per year to update and maintain its productive capacity and to increase the recovery of by products, particularly molybdenum. In 1977 at the Chuquicamata Division, Codelco upgraded mining equipment by adding the first of two new 28-cubic-yard electric shovels and twelve 170-ton off-highway haulage trucks. Addi-

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Table 3.—Chile: Copper mine production

(Metric tons, copper content)

	1976	1977	Change (percent)
CODELCO-Chile:			
Chuquicamata	445,500	477,600	+7
El Salvador	82,700	80,300	-3
El Teniente	261,700	275,900	+5
Andina	56,900	58,900	+4
Total	846,800	892,700	+5
Medium and small mines:			
Mantos Blancos	30,100	e30,000	--
ENAMI	74,300	e78,500	+6
Disputada	35,700	e35,000	-2
Others	18,300	e20,000	+9
Total	158,400	163,500	+3
Grand total	1,005,200	1,056,200	+5

eEstimate.

Sources: Comisión Chilena del Cobre (Santiago). Producción y Exportaciones Chilenas de Cobre. Boletin, November 1977, January 1978; and CODELCO-Chile 1977 Annual Report.

Table 4.—Chile: Copper reserves in 1977

Ore Deposit	Measured		Indicated		Inferred	
	Quantity (million tons)	Grade (percent copper)	Quantity (million tons)	Grade (percent copper)	Quantity (million tons)	Grade (percent copper)
Operating mines:						
Chuquicamata	624	1.38	911	.99	8,853	.46
Exotica	164	1.61	16	1.61	--	--
El Salvador	150	1.28	125	1.04	37	1.16
Andina	120	1.29	200	1.10	100	.80
El Teniente	2,850	1.16	1,200	.90	4,300	.30
Disputada	100	1.40	--	--	--	--
Mantos Blancos	50	1.50	--	--	--	--
Total	4,058	1.23	2,492	.96	13,290	.41
Ore bodies in development						
El Abra	--	--	1,368	.59	--	--
Pelambres	--	--	430	.78	--	--
Andacollo	--	--	300	.69	--	--
Pampa Norte	--	--	242	.70	--	--
Others	--	--	--	--	800	.90
Grand total	4,058	1.23	4,832	.80	14,090	.44

Source: American Metal Market. V. 85, No. 150, Aug. 4. 1977, p. 18.

tional projects to be completed between 1978 and 1981 included adding 80 new flotation cells to the scavenger cleaning circuit at the concentrator to increase capacity from 77,000 tons per day to 99,000 tons per day; converting eight sections of the tankhouse from electrowinning to electrolytic copper refining; and enlarging smelter casting capacity by adding a modified converter, two turboblowers, and an oxygen plant. The heat-recovery boilers are also being replaced.

At El Salvador, investments were directed toward equipment maintenance and replacement, improvement of the hydroelectric plant, and in increased mine area exploration. At Andina, work continued on the second stage of the molybdenite recovery plant and to expand copper mill capacity to 14,000 tons per day. Both projects are expected to be completed in 1978. Development of 4,800 meters of water control and diversion tunnels for the new Los Leones tailings dam at Andina continued as did design work to recover byproduct tourmaline from the mine in the future.

During 1977 the El Teniente Division completed work on the first stage of the 180 million-cubic-meter-capacity Colihues tailings dam and the addition of new pulp circuits and an automatic sampling and analyzing system in 23 circuits of the Colon concentrator. During 1977 100% of the basic engineering and 75% of the design engineering were completed on the Futura mine project at El Teniente. The existing

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North and South mines are located in nearly exhausted softer secondary copper ore zones where conventional block caving mining methods are used. The Futura mine is an extension of the Teniente No. 4 level into the harder primary ore zone. A modified block caving operation and a 30,000-ton-per-day underground crusher will be installed to reduce the ore boulders to a minus 10-inch size treatable at the Colon concentrator. The project should be completed by late 1978.

Chile's competitive position and future strength in the world copper market lies in its tremendous copper resource base as shown in table 5. Measured and indicated reserves as shown represent about 20% of all known world copper reserves. Chile's efforts to develop its copper resources are highlighted under the discussion on foreign investment earlier in this chapter. In addition, active bidding is continuing for the rights to develop the El Abra and Los Pelambres deposits. A detailed description of the geology of the El Abra porphyry copper deposit was published during the year.[5]

Iron Ore.—Pressured by continued weak iron ore markets, a Government-owned but independently operated organization Compañia de Acero del Pacifico S.A. (CAP) cut back iron ore production for the second year in a row to allow for the further reduction of excess stocks. With a drop in demand, particularly for direct-shipping ore, CAP elected to close down the high-cost Incahuasi district, which includes the Desvio Norte and Cristales mines of the Sante Fe Division. Iron ore production decreases were experienced in all three divisions: El Algarrobo mines dropped 22% to 1,862,000 long tons, El Romeral mines down 19% to 3,287,000 long tons, and Santa Fe mines by 28% to 2,386,000 long tons. Drawing down stockpiles by 500,000 long tons, CAP marketed over 8 million long tons in 1977. Of this amount 92% was exported, representing a 16% drop in sales from those of 1976. CAP received an average price of $10.70 per long ton of iron ore for the year. New production of pellets is expected to increase the average price earned 2.5 times.

The $250 million Huasco Valley Project, which includes a beneficiation plant at El Algarrobo, a pellet plant at Huasco, and the Guacolda Port pellet storage and shiploading facilities, began operation in December 1977 with the official plant inauguration scheduled for March 15, 1978. A group of five Japanese steel mills led by Mitsubishi Corporation of Tokyo has contracted to purchase 33 million tons of Huasco pellets over the next 10 years.

A description of the geology of the El Romeral magnetite mine in relationship to a 30-kilometer-wide by 600-kilometer-long belt of magnetite and phosphatic apatite-magnetite iron ore deposits was also presented during the year.[6] On January 1, 1977, Chile withdrew its membership in the Association of Iron Ore Exporting Countries.

Iron and Steel.—Aided by a recovering domestic economy that absorbed 83% of all steel product shipments in 1977, CAP increased production to about 75% of capacity at the Huachipato steel complex. Pig iron production increased 7% to 432,000 tons, steel ingots 14% to 547,000 tons, and semifinished steel products 15% to 427,000 tons.

Annual sales revenues for CAP including iron ore, steel products, and byproducts increased by nearly 10% to $222 million. It was noted, however, that the average price received per ton of steel products was $385 for domestic market sales compared with only $251 for export sales. CAP suffered a net loss for the year as revenues were countered by the high-interest payments on the capital costs of the Huasco Valley and Huachipato modernization and expansion projects. In order to keep costs down, CAP has started a new policy of only producing on order. Because CAP operates independently, it must stand on its own financially. By the end of 1977, CAP had completely phased out its older Siemens-Martin electric furnaces and brought on-line two Linz-Donawitz converters with a combined capacity of 1 million tons. Second-stage milling capacity, however, is only 750,000 tons per year.

Molybdenum.—Chile maintained its position as the world's third largest molybdenum producer following the United States and Canada.

Production and shipments were up marginally for the year. Shipments from Codelco-Chile of molybdenum, ferromolybdenum, and molybdenum oxide amounted to 11,567 tons, with 29% of this amount consumed domestically. Approximately 64% of all molybdenite concentrates came from the Chuicamata mine as a byproduct of copper beneficiation. Chuquicamata is currently producing at a rate of 7,000 tons of molybdenum per year, and El Teniente at a rate of 2,500 tons per year. Newly published estimates of Chile's molybdenum reserves are

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Table 5.—Chile: Molybdenum reserves

	Measured		Indicated		Inferred	
	Quantity (million tons)	Grade (percent molybdenum)	Quantity (million tons)	Grade (percent molybdenum)	Quantity (million tons)	Grade (percent molybdenum)
El Teniente	2,850	0.04	1,200	0.02	4,300	0.02
Chuquicamata	624	.06	910	.04	8,885	.02
Others	370	.016	1,085	.028	207	.09
Total	3,844	.041	3,195	.028	13,392	.021

Source: American Metal Market. V. 85, No. 212, Nov. 1, 1977, p. 22.

shown in table 5. Codelco-Chile is also planning on expanding molybdenite production at the El Salvador mine with a new $250,000 plant scheduled for opening in early 1979.

Precious Metals.—Byproduct copper production continued to be the principal sources of precious metals in Chile, accounting for 66% of all gold and 92% of all silver output in 1977. Silver production reached over 8 million ounces in 1977 but is expected to peak out in 1978 as Chilean copper production levels off and begins a decreasing trend for at least the next 5 years.

St. Joe Minerals Corp., as previously mentioned, signed an agreement to conduct further examination of the El Indio gold-copper-silver deposit. St. Joe would have an 80% interest in the project and is expected to announce development plans in mid-1978.

Uranium.—The Chilean Nuclear Energy Commission (CCEN) is currently considering proposals by Wyoming Minerals Co. to recover uranium from the copper tailings at Chuquicamata and by Union Oil Co. for exploration rights in the Aisen area of south-central Chile. Wyoming Minerals has a similar operation producing uranium from tailings at the Bingham copper mine of Kennecott Copper Corp. in Salt Lake City.

While there is no commercial production of uranium in Chile, CCEN is operating two experimental nuclear reactors, one at La Reina and one at Lo Aguirre.

NONMETALS

Iodine.—As one of the worlds three largest producers of iodine, the state-owned Sociedad Quimica y Minera de Chile (SOQUIMICH) reversed a trend in decreasing production as iodine output increased 16% to 1,652 tons in 1977.

Lithium.—Chile possesses approximately 1,270,000 tons of lithium, representing 64% of known world reserves. The lithium is found in the potassium-rich brines of the Salar de Atacama 280 miles from Antofagasta in northern Chile. The Foote Mineral Co. of the United States following 3 years of exploration and negotiation has reached an agreement with Corporacíon de Formento de La Produccion (CORFO) to study and possibly develop these deposits. The joint partnership will be called Sociedad Chilena de Litio (SCL). SCL has reached agreement with the Chilean Nuclear Energy Commission that the commission has the option to buy 10% of the lithium produced in any given year. All potassium chloride is the property of CORFO at exploration sites, but all magnesium, less 10% for CORFO, belongs to SCL.

Nitrates.—In 1976, SOQUIMICH experienced a slight drop in sodium nitrate production and a substantial decrease in enriched potassium nitrate production of over 33%. No new actions were taken during the year to improve the deteriorating condition of the nitrate industry in Chile.

MINERAL FUELS

Coal.—Production of bituminous coal by Empresa Nacional del Carbon S.A. (ENACAR), remained in the range of 1.2 million to 1.3 million tons for the year, with all coal consumed domestically. A December 1977 World Coal report states that the new thermoelectric plant at Quintero, Ventana II, will use 580,000 tons of coal per year. The plant, with a capacity of 210,000 kilowatts, is the largest in the country. With demand forecast to increase in the next decade, particularly with a Government policy of substituting coal for oil in industrial uses, work is continuing on feasibility studies to develop the estimated 4.7 billion tons of coal in the Riesco Island, Brunswick Peninsula, and the Natalles area of Magallanes.

Petroleum and Natural Gas.—Crude petroleum and natural gas production continued to drop in 1977 as the natural depletion of old wells continued. Empresa Na-

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cional del Petróleo (ENAP), however, expects this trend to reverse itself by late 1978 as the newly discovered offshore Ostion well in the Straits of Magellan comes into production. When in full production, Ostion will help almost double national production to 16 million barrels per year. This will be a substantial boost to an economy that in 1977 depended on petroleum and its derivatives for 75% of its energy, but produced only 25% of its oil needs. (The figure approaches 30% to 35% if one includes liquid and natural gas.) Highlighting a report on petroleum development for the year, Chile Economic News noted that "reserves in the explored areas of Magallanes are estimated at 280 million barrels of oil and 5.5 trillion cubic feet of natural gas." Efforts are being made to interest foreign investors in exploration of zones where studies indicate good possibilities of petroleum deposits, to intensify exploration by ENAP in the Magellan Strait, and to develop projects for liquefaction and sale of gas from the Magallanes area.

A modification by Decree-Law 1089, which limits the role of the state may take in exploration and exploitation of oil deposits has opened new possibilities for investment by private companies and international concerns. A 35-year contract was signed in December 1977 with Atlantic Richfield Company and Amerada Hess Company for the exploration of a 500—kilometer stretch of Chile's Pacific continental shelf. The agreement calls for investments of from $240 million to $1.4 billion depending on the size of the deposits and stipulates that 60% of the profits will accrue to Chile and the remainder to the contractors.

In January 1978, ENAP will begin an operation known as the "Costa Afuera" offshore plan, drilling over 1,000 wells in the Magellan Strait. A 1969 study made in collaboration with the United Nations estimated the reserves in this area to be between 160 million and 190 million barrels of oil and between 2.6 and 3.5 billion cubic feet of natural gas. The program calls for two types of wells. Approximately 150 exploratory probes will help establish the limits of the deposits and indicate the best locations for fixed platforms such as those constructed in Loredo Bay, each providing the facilities for 9 or 10 drillings. The rest of the wells, about 800 of which are expected to be productive, are intended to extend and develop the oil beds. Oil from the Magellan Strait should begin flowing to refineries by September 1978, contributing a 25% increase to the national production at first and exceeding 40% within 5 years. The investment required is estimated at $273 million. Increased capacity for the present refineries has been planned to reach about 40 billion barrels by 1985. This project demands an investment of nearly $200 million.

Plans are also being made to tap the deposits of natural gas. Currently, the methane found in the Magellan Strait is not being put to commercial use, and only about 5% of the butane found in the oil wells is sold. Geographic conditions make construction of gaslines too costly. Construction of a liquefied natural gas plant and special transport vessels will require about $1 billion, but has been chosen as an alternative to make the export of gas in a liquid form possible.[7]

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[1]Supervisory physical scientist, Branch of Foreign Data.
[2]Where necessary, values have been converted at the rate of 27.98 Pesos = US$1.00.
[3]Chile Economic News. The Foreign Investment Law. Corporación de Fomento de La Producción, New York, No. 78, October 1977, p. 11.
[4]U.S. Embassy, Santiago, Chile. GOC Modifies Mining Code. State Department Airgram A-58, April 1977, 2 pp.
[5]Ambrus, J. Geology of the El Abra Porphyry Copper Deposit. Econ. Geol., v. 72, 1977, pp. 1062-1085.
[6]Bookstrom, A. A. The Magnetite Deposits of El Romeral, Chile. Econ. Geol., v. 72, 1977, pp. 1101-1130.
[7]Chile Economic News. No. 82, January 1978, p. 10.

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The Mineral Industry of the People's Republic of China

By K. P. Wang[1]

Whereas 1976 was a year of earthquakes, major political events, and industrial unrest, 1977 became the year of return to normalcy and record production levels for the People's Republic of China (China). Under Chairman Hua Kuo-Feng's pragmatic program for rapidly expanding industry along with agriculture, three or four thousand workers and managers had come from all parts of China to the famous Taching oilfield near Harbin in 1977 to learn the technology of this enterprise. An 8-year plan announced early in 1978 to end in 1985 calls for the development of 120 large-scale projects, including 10 iron and steel complexes, 9 nonferrous metal complexes, 8 coal combines, 10 oil and gas fields, 30 power stations, 6 new trunk railways, and 5 key harbors.[2] China was once more embarking upon rapid economic growth.

China's total gross national product (GNP) was over $320 billion in 1977, placing the country solidly within the first six countries of the world. China's GNP has been growing at an annual rate of up to 10% in recent years, although growth was much less in 1976. As an order of magnitude, minerals and metals together contributed more than 10% of the 1977 GNP.

A National Geological Conference was convened during July 1977, indicating the importance attached to this general subject for China's planners in their overall program of "four modernizations"—agriculture, industry, national defense, and science and technology. It was reported that the number of geologists exceeds 50,000 and drillers and prospecters total several hundred thousand.[3]

As of late 1977, China had completed a 1:1,000,000-scale geological map of China, a 1:2,000,000-scale geological map of Asia (published), many 1:200,000-scale and 1:50,000-scale regional geological maps within China, and a 1:4,000,000-scale tectonic map of China.[4] To support the "four modernizations" program, the Geological Survey or Geological Bureau plans to substantially ascertain China's mineral potential within 5 to 10 years, with particular emphasis on high-grade iron ore, water resources, fertilizer raw materials, coal in the south, and geothermal energy.

A leading member of the Chinese Geological Survey has stated that of more than 140 kinds of useful minerals known to the world, reserves of 132 of these occur in China in quantities large enough for exploration and use.[5] Also, China's reserves of 17 kinds of minerals are very large by world standards, including coal, oil, copper, tungsten, antimony, molybdenum, salt, magnesite, limestone, fluorspar, and phosphates. Many potential oil formations have been discovered around the country as a result of reconnaissance surveys over a million square kilometers of sedimentary basins. There has been success in finding coal in the south. China's "Mesabi-type" iron ranges in the north have been carefully mapped. Very large skarn-type copper deposits reportedly have been located. Work has been done on the relationship between tungsten mineralization and tectonics in Kiangsi Province. In the Hochih area of Kwangsi Province (known for tin in the past), three large and two medium-sized "colored metal" (generally means nonferrous) deposits reportedly have been discovered recently. An important selenium-bearing cupriferrous-pyrite deposit was found in Kwangtung Province; also, an extensive zeolite deposit in the Lishui district of Chekiang Province together with

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many occurrences in nearby areas. A large "natural soda" deposit has been discovered in Tungpai Hsien of Nanyang district, Honan Province.

Another National Conference on Coal was convened in January 1978 to discuss work in the next decade and plans for further mechanization. China started to move toward developing or expanding specific coal mines for new markets, including promoting exports and buying foreign equipment and know-how to increase production. The Kailan (Kailuan) combine was brought back to the pre-earthquake output level of 70,000 metric tons per day (tpd) at yearend 1977, after most of its structures had been nearly flattened and all seven coal mines severely shaken and flooded 18 months ago. Shansi, the leading coal-producing Province, produced at a record pace of over 80 million tons per year (tpy). The 1977 output of two relatively new coal combines—Pingtingshan in Honan and Huaipei in Anhwei—was reported at about 11 million tpy each or roughly twice the production of a third fairly new combine, Feicheng in Shantung. Shensi Province completed the first phase of its largest "modern" coal mine called Fangshuping.

The Chinese petroleum industry was expanding in many directions, although nothing much had been said about the Takang field near the earthquake area. Finding more oil at greater depths and around the perimeters of existing fields of Taching and Shengli is most significant. The new Huapei or north China field had come into prominence, and samples of this and Shengli's oil were sent to Japan in anticipation of exports in the future. Oil and gas had been discovered in the central-southern part of east China, including the Sanshui (Samsui) basin of Kwangtung Province.

While concentrating on their own technical resources for exploration onshore, the Chinese were looking more into foreign equipment and know-how for offshore operations. Generally, they feel that over 40% of China's land area and half that much continental shelf area have potentially oil- and gas-bearing sedimentary rocks. Peking indicates that it had sailed research vessels to near Tiaoyutai and started exploration in the controversial South China Sea. As of yearend 1977, China was operating three foreign-built rigs, had a fourth on order, and finally purchased a fifth.[6] The program to build refineries, petrochemical facilities, pipelines, loading docks, and tankers was similarly moving ahead. Aside from Japan and other markets, China made an arrangement with France in January 1978 to ship half a million to a million tons of crude oil annually to France starting immediately.

Within the $2 billion deal (see below under Trade) to swap Chinese fuels for Japanese industrial plants and know-how, the role of steel stands out. The Chinese are clearly trying to produce more steel in the years ahead by new large plants, partly with the thought of cutting down on steel imports. To accommodate them and to gain a special position in the rapidly expanding China trade, the Japanese steel companies feel that helping to build producing facilities in China and provide transport and supporting services and know-how can earn them large dividends. Eventually slurrying Chinese coal and oil in Japanese pipe and then loading the slurry on to ships made by both parties is a good example of the future implications of this relationship.

Much basic construction on steel facilities has been done in China recently. The Wuhan steelworks was substantially completed, after several years of problems. The Anshan steelworks will be enlarged up to 12 million tpy steel capacity through rebuilding and modernization along the lines of the rejuvenated Yawata steelworks. Apparently, the Peking steelworks and possibly the Penchi steelworks will also be streamlined with Japanese help, on roughly half the scale of Anshan. A new 6-million-tpy steelworks is to be built in the Shangai area, with two blast furnaces of more than 4,000-cubic-meter capacity, three oxygen converters of 250 to 300 tons, continuous casting mills, and various rolling mills. Shansi may be another potential site.

China's 13 large foreign fertilizer plants were all scheduled to be in operation in a year or two. Simultaneously, many small and medium fertilizer facilities were also to be constructed. Reportedly, the Chinese have asked Kellogg to bid on additional coal-fired ammonia plants. Chemicals, petrochemicals, and industrial salts will be stressed. Production capacity of construction materials probably will be more than doubled in capacity in a decade, with equal stress on large and small cement works and additional emphasis on downstream products. Included in new nonmetallic facilities cited for good performance were the Shennan asbestos mine in Shensi, the Tangshan

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kaolin plant in Hopeh, the No. 4 mica mine in Sinkiang, the Yaan mica processing plant in Szechuan, and the Changchow construction materials plant in Kiangsu.

China's biggest pyrite mine (open pit) being built in Yunfu, Kwangtung Province, was near completion. Kiangsi's new underground salt mine and works at Chingkangshan produces enough salt for the Province's 28 million people. The work on saline lakes and playas done by the Tsinghai Salt Lake Institute should be of importance to the chemical industry. Of aesthetic interest is a report[7] stating that 11 locations in Ninghsia Province have rich semiprecious stone resources, including agate, jasper, malachite, azurite, amethyst, and bronchantite that are important for carving, industrial, and jewelry use.

Two successful nuclear tests took place in 1977, China's 22d and 23d. The first was on September 17—a small (less than 20-kiloton) atmospheric blast. The second was on November 23, when an intermediate-range ballistic missile with nuclear warhead was launched in Kirin Province and guided to hit the Takla Makan Desert in Sinkiang.

The Chinese stated without details that their nuclear effort had become integrated, that they will redouble their efforts to attain world technical levels, and that very extensive resources of uranium had been ascertained.[8] One of the general areas mentioned for metalliferrous and uranium ore finds is the Yunnan-Kweichow Plateau. In earlier years, China's uranium came from places like Chuannan in Kwangsi and Weiyuan in Kwangtung.

The Chinese interest in nuclear energy appeared to be more intense than a few years ago. A news item states that the Chinese are prepared to talk to French nuclear power equipment representatives who are scheduled to accompany Premier Raymond Barre to Peking in early 1978.[9] Chinese nuclear power specialists visited Japan in 1972 and Canada in 1973. Very likely, the Chinese are thinking about large-scale nuclear power generation by the 1980's.

China's electric power industry, ranking about ninth in the world and having a capacity roughly one-tenth that of the United States, continued to expand.[10] Power output and installed capacity both rose by about 10% during 1977 (over that of 1976), the former being roughly 150 billion kilowatt-hours and the latter perhaps 43 million kilowatts. Whereas hydroplants possessed approximately one-third of China's electric power capacity, their contribution to electricity output was closer to one-fourth because of the intermittent nature of hydropower generation. Three-fourths of the thermal electric power was derived from coal and much of the rest from oil. All kinds of fossil fuels have been burnt directly, including low-rank coals, low-grade coals, crude oil, shale oil mixed with coal, and more recently "stone coal" (bone coal) presumably mixed with high-grade fossil fuels. Gas turbines are not yet important, although Szechuan Province is building many plants to use natural gas.

A major thrust was being made to build up the electric power industry—both large and small plants. The Chinese were thinking in terms of adding more than 50% capacity by 1980 and at least another 150% by 1983, compared with the capacity existing in 1977. They believe that China's hydropower resources total in excess of 500,000 megawatts—the largest in the world including 230,000 kilowatts in the Yangtze system and 100,000 kilowatts in the Yalu Tsangpu River of Tibet. China's coal resources are also very extensive by world standards, and its oil is potentially most important. Thus, there should not be any shortage of energy in China for decades to come, provided sound plans are implemented.

Over 40 large- and medium-sized hydroelectric and thermal generating units were put into operation in China during 1977.[11] More than a dozen such units were operating in faraway places like Sinkiang and Inner Mongolia. Thermal power stations were built near the pitheads of the Huainan and Huaipei coal combines for direct conversion to electricity. New power-generating units with combined capacity of 765 megawatts and about 500 kilometers of high-voltage transmission lines were built in 1977 as part of the effort to renovate the Peking-Tientsin-Tangshan power grid seriously damaged by the July 1976 earthquakes. When all four generating units are completed, the Touho thermal power station near Tangshan will be one of China's biggest. During the past decade, many small powerplants with combined generating capacity of 2.5 million kilowatts have been installed in Shantung Province.

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PRODUCTION

China improved its position as one of the world's important mineral producers (see table 1). The country's position as a leading producer of bituminous coal, anthracite, tungsten, antimony, tin, manganese, mercury, bismuth, and salt had been known for some time. In recent years, China also achieved ranking among the first five in iron ore, steel, magnesite, cement, pyrite, phosphate rock, nitrogen fertilizers, asbestos, graphite, fluorspar, and high-grade talc. China has moved into the first 10 in the production of petroleum, natural gas, rare-earth elements, rare and high-purity metals, and barite for oil drilling. Generally, overall mineral and metal production increased significantly over that of 1976, as more idle capacity became utilized. China's mineral output and basic resource position have been described in a recent publication.[12]

Even though Kailan was producing at about half of its historic peak annual rate because of the rehabilitation work following the earthquakes, China's coal output apparently registered up to a 10% gain over that of 1976. The oil industry attained the yearly capacity of 100 million tons, with Taching adopting more efficient recovery methods and Takang still trying to fully overcome the dislocations resulting from the earthquakes. Natural gas production reportedly gained more than a fifth over that of 1976 and was approaching the 100-billion-cubic-meter annual level. An increasing share of the gas was being utilized with the completion of more local and faraway pipelines.

The steel industry was clearly getting out of its doldrums, with production in the second half of 1977 at close to plant capacities. Basic construction at various steel plants was also being completed so that the 30-million-tpy output level became clearly in reach. Steel projects implemented would add 10 to 15 million tons of annual capacity to China's total within 5 years. The cement industry continued to move ahead in 1977, with China replacing the Federal Republic of Germany as the world's fourth largest cement producer.

The famous export metals like tungsten, antimony, and tin appeared in lesser quantities in world markets than in 1976, but this did not mean that production had decreased. Larger quantities and greater varieties of "rare metals" were produced. China further improved its position in both nitrogenous and phosphatic fertilizers, spurred in part by the overall growth in the use of fuels and despite the fact that half the large new chemical fertilizer plants had not yet really come in to play. The Chinese salt industry, which mainly utilized seawater, approached the output of the United States—the only larger salt producer than China. China remained prominent in nonmetallics like pyrite, magnesite, asbestos, barite, fluorspar, and talc.

Table 1.—People's Republic of China: Estimated production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Aluminum:			
Bauxite, gross weight[2]	990,000	990,000	1,200,000
Alumina, gross weight	520,000	520,000	650,000
Metal, primary, refined	200,000	200,000	250,000
Antimony, mine output, metal content	12,000	12,000	12,000
Bismuth, mine output, metal content	250	250	250
Cadmium, smelter production	110	110	110
Copper:			
Mine output, metal content	100,000	100,000	100,000
Metal, smelter	100,000	100,000	100,000
Metal, refined	150,000	150,000	150,000
Gold, mine output, metal content troy ounces	50,000	60,000	60,000
Iron and steel:			
Iron ore, gross weight[3] thousand tons	65,000	65,000	65,000
Pig iron and ferroalloys do.	32,000	30,000	30,000
Crude steel do.	29,000	27,000	30,000
Rolled steel do.	22,000	20,000	23,000
Lead:			
Mine output, metal content	100,000	100,000	100,000
Metal, refined	100,000	100,000	100,000

See footnotes at end of table.

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Table 1.—People's Republic of China: Estimated production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS —Continued			
Magnesium metal, primary	1,000	1,000	1,000
Manganese ore, gross weight thousand tons	1,000	1,000	1,000
Mercury, mine output, metal content 76-pound flasks	26,000	26,000	20,000
Molybdenum, mine output, metal content	1,500	1,500	1,500
Silver, mine output, metal content thousand troy ounces	800	965	965
Tin:			
Mine output, metal content	22,000	20,000	20,000
Smelter	22,000	20,000	20,000
Tungsten, mine output, metal content	9,000	9,000	9,000
Zinc:			
Mine output, metal content	100,000	100,000	100,000
Refined	100,000	100,000	100,000
NONMETALS			
Asbestos	150,000	150,000	200,000
Barite	250,000	300,000	300,000
Cement, hydraulic thousand tons	30,000	35,000	44,100
Fertilizer materials:			
Natural:			
Crude phosphate rock do	3,400	4,000	4,100
Potash, marketable, K_2O equivalent[4 5]	[r]300	[r]300	300
Manufactured, nitrogenous, N content[4 5]	3,000	4,000	4,000
Fluorspar	350,000	350,000	350,000
Graphite	50,000	50,000	55,000
Gypsum	900,000	1,000,000	1,000,000
Magnesite thousand tons	1,000	1,000	1,000
Pyrite, gross weight[6] do	2,000	2,000	2,000
Salt do	30,000	30,000	35,000
Sulfur:			
Native	130,000	150,000	170,000
Content of pyrite	900,000	900,000	950,000
Byproduct, all sources	120,000	320,000	330,000
Total	1,150,000	1,370,000	1,450,000
MINERAL FUELS AND RELATED MATERIALS			
Coal:			
Anthracite thousand tons	20,000	20,000	30,000
Bituminous and lignite do	450,000	460,000	470,000
Total do	470,000	480,000	500,000
Coke, all types do	28,000	28,000	28,000
Gas, natural:			
Gross production billion cubic feet	[r]2,300	[r]2,900	3,400
Marketed production do	[r]2,000	[r]2,600	3,100
Petroleum:			
Crude (including crude from oil shale) thousand 42-gallon barrels	584,000	657,000	730,000
Refinery products do	475,000	548,000	650,000

[p]Preliminary. [r]Revised.

[1]In addition to the commodities listed for which quantitative estimates of output have been made. The People's Republic of China is known or is believed to have produced the following commodities for which no estimates, even of order of magnitude, have been prepared, owing to a paucity of general information upon which to base an estimate: Arsenic, chromite, nickel, titanium minerals, uranium, boron minerals, various clays (including kaolin), feldspar, lime, mica, various industrial and dimension stone, sand, and carbon black. Other unlisted commodities also may be produced.

[2]Diasporic bauxite; includes estimated 163,000 metric tons annually of production for refractory applications.

[3]In terms of 50% Fe ore.

[4]Data are for years ending June 30 of that stated.

[5]Source: British Sulfur Corp. Ltd. Statistical Supplement No. 18, November-December 1978.

[6]Sulfur content of pyrite has been listed under "Sulfur."

TRADE

China's overall foreign trade has not shown much change in the last few years. A significant part of imports in 1973-74 was for industrial equipment and plants; however, subsequent imports were weighed much more heavily in metals, fertilizer, and nonmineral materials. The Chinese have tried hard to export more oil and other products so as to have foreign exchange to buy equipment and plants for industrialization. There was a trade deficit of about $1.5 billion in 1974; however, a somewhat balanced situation existed in 1976. Trade in 1977 at possibly $14.5 billion was up slightly

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from that of 1976, and there was a surplus of up to $2 billion in the latter year.

The trade outlook at yearend showed that some major changes were in the offing, with projected increases in overall volume and larger sales of fuels along with purchases of "tools" of industrialization. Initially, more emphasis on trade with Japan and Western Europe rather than the United States was expected because of Sino-American normalization problems. The European Economic Community or the Common Market was about to make a 5-year agreement with China to expand trade both ways and with "favorable treatment." Sino-West European trade totaled about $2.5 billion in 1976 and possibly $2 billion in 1977, with the foreign exchange balance shifting from $390 million in favor of the Community in 1976 to perhaps $100 million in favor of China in 1977. According to an unconfirmed report at the turn of the year, China apparently ordered about $300 million of mining equipment from Britain for extracting coal and other minerals and a second similar order may follow. The equipment would be used to develop Chinese coal mines to supply an electric powerplant to be built in Hong Kong with up to 3.5 million tpy of coal starting in the early 1980's. Total U.S.-China trade has dwindled to about a third of a billion dollars in 1976 and only $375 million in 1977, and minerals were not important.

Total trade with Japan was about $3.8 billion ($2.3 billion exports by Japan) in 1975, $3.0 billion ($1.7 billion exports by Japan) in 1976, and reportedly $3.5 billion in 1977. The major trading deal signed with Japan in early 1978 involving $20 billion total both ways during an 8-year period, would be in addition to normal trade.[13] This move indicates a pragmatic approach by Chinese leadership to build up a modern industrial base, and Japanese interest in gaining a foothold on China's expanding market. Japan will sell $7 to $8 billion in plants and technology and $2 to $3 billion in construction materials during the first 5 years. There could be a dozen large industrial plants covering steel, copper, fertilizers, natural gas, petrochemicals, building materials manufacture, leader, television, plastics, conveyors, etc. The Chinese will ship about 47.1 million tons of crude oil and 8.4 to 9.2 million tons of coal (including 5.1 to 5.3 million tons of coking coal and 3.3 to 3.9 million tons of steam coal) during 1978-82 plus additional tonnages of these fuels in 1983-85. China initially asked for the most favorable possible terms of payment for Japanese products but finally agreed to the principle of deferred payments whereby Japan would loan China some of the money with interest no lower than 7.5%.

Table 2.—People's Republic of China: Apparent exports of selected mineral commodities[1]

(Metric tons, unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Bauxite and concentrates	103,119	139,158	Italy 54,030; Canada 24,988; West Germany 22,966.
Oxide and hydroxide	2,300	5,100	All to Finland.
Metal including alloys, all forms	NA	11	All to Italy.
Arsenic, oxide and acids	976	1,222	Italy 564; Australia 279; New Zealand 230.
Copper metal including alloys, all forms	262	[2]125	All to Belgium-Luxembourg.
Iron and steel, metal:			
Pig iron, ferroalloys, similar materials	241	919	Sweden 491; Belgium-Luxembourg 235.
Semimanufactures:			
Tubes, pipes, fittings[2]	51	130	Spain 68; Finland 48.
Other	[2]19	99	All to France.
Lead metal including alloys, all forms	25	100	Do.
Manganese:			
Ore and concentrate	48,202	39,177	Japan 37,486.
Oxide and hydroxide	2,987	574	Sweden 290; Denmark 234.
Mercury 76-pound flasks	4,263	6,960	United States 4,263; Australia 928; Italy 493.
Tin metal including alloys, all forms	11,337	5,580	United States 1,727; Netherlands 1,000; West Germany 802; France 658.
Titanium oxides	[2]216	799	Japan 669; Italy 130.
Tungsten ore and concentrate	5,398	4,351	West Germany 1,297; Austria 1,043; Sweden 958.

See footnotes at end of table.

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Table 2.—People's Republic of China: Apparent exports of selected mineral commodities[1] —Continued

(Metric tons, unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Zinc metal including alloys, all forms	3,655	5,131	United States 2,297; United Kingdom 605; Switzerland 542.
Other:			
Ore and concentrate, n.e.s.[2]	2,733	1,862	Japan 979; Hungary 300; France 250; Yugoslavia 188.
Oxides, hydroxides, peroxides of metals, n.e.s.[2]	426	154	Sweden 60; Austria 36.
Metalloids	3	(3)	
Nonferrous metals including alloys, all forms, n.e.s.[2]	975	1,330	Japan 811; West Germany 227.
NONMETALS			
Abrasives, n.e.s.[2]	324	281	All to Japan.
Asbestos	1,384	3,214	Japan 2,242; Italy 672; Australia 300.
Barite and witherite[2]	50,513	12,558	Japan 5,639; United Kingdom 3,170; France 2,003.
Boron materials, oxide, acid	120	235	All to Japan.
Clay and clay products:			
Crude clays, n.e.s	80,602	55,802	Japan 50,773; West Germany 3,499; United Kingdom 1,530.
Products:			
Refractory	3,913	1,673	All to Japan.
Nonrefractory value, thousands	$28	NA	
Cryolite and chiolite	5,221	2,732	All to United States.
Diamond:			
Gem, not set or strung value, thousands	$840	$2,591	United Kingdom $1,009; Belgium-Luxembourg $949.
Industrial do.	$2,106	$806	All to Belgium-Luxembourg.
Feldspar and fluorspar	195,044	158,439	Japan 120,254; Australia 25,144.
Fertilizer, crude, phosphatic	9,238	NA	
Graphite, natural	10,867	10,585	West Germany 4,006; United States 2,358; France 1,195; Japan 1,119.
Magnesite	50,278	41,242	West Germany 11,174; Netherlands 6,218; United Kingdom 4,930.
Mica, crude	4,017	5,013	United Kingdom 3,292; West Germany 749; Netherlands 700.
Pigments, iron oxides	1,111	504	All to Hungary.
Precious and semiprecious stones, except diamonds value, thousands	$424	$3,490	Japan $1,838; United States $1,251.
Salt[2] thousand tons	100	85	All to U.S.S.R.
Stone and sand and gravel:			
Dimension stone:			
Crude and partly worked	10,940	8,327	All to Japan.
Worked	2,351	[2]1,191	Japan 821; West Germany 286.
Gravel and crushed rock	2,590	2,616	All to Japan.
Quartz and quartzite	16,415	[2]6,295	Do.
Other nonmetals, n.e.s.:			
Crude	2,924	2,483	Japan 1,537; Australia 931.
Slag, dross, and similar waste, not metal bearing, from iron and steel manufacture	5,500	9,900	All to Japan.
Oxides and hydroxides of magnesium, strontium, barium[2]	2,058	2,694	All to Finland.
MINERAL FUELS AND RELATED MATERIALS			
Coal	455,784	327,259	Japan 321,959; Belgium-Luxembourg 5,300.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	57,407	44,223	All to Japan.
Refinery products:			
Residual fuel oil do.	NA	227	Do.
Lubricants value, thousands	$74	$68	Australia $49.
Other:			
Mineral waxes thousand 42-gallon barrels	90	168	Australia 56; Italy 34; New Zealand 14; Japan 13.
Petroleum coke	336	579	All to Japan.

NA Not available.

[1]Compiled from data of Australia, Austria, Belgium-Luxembourg, Canada, Denmark, Finland, France, West Germany, Greece, Hungary, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, U.S.S.R., United Kingdom, United States, and Yugoslavia.

[2]Partial figure; tonnage not available for all destinations.

[3]Tonnage not reported; total exports: $228,000, of which United Kingdom $133,000, Belgium-Luxembourg $39,000, and United States $38,000.

Source: For Hungary, Poland, and the U.S.S.R.—official trade statistics of the respective country; for all other countries—Statistical Office of the United Nations 1975 and 1976 Supplement to the World Trade Annual, v. 5 (the Far East), Walker and Co., New York, 1976, pp. 143-181.

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Table 3.—People's Republic of China: Apparent imports of selected mineral commodities[1]

(Metric tons, unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Oxide and hydroxide	515	204	Japan 129; France 75.
Metal including alloys:			
Unwrought	318,477	116,847	United States 37,349; Canada 22,895; West Germany 21,798.
Semimanufactures	860	r2,090	Japan 780; France 496.
Cobalt, metal, unwrought kilograms	r13,801		
Copper metal including alloys, all forms[2]	NA	70,215	Peru 23,371; Chile 22,900; Zambia 20,000.
Iron and steel:			
Ore and concentrate thousand tons	1,436	1,370	All from Australia.
Metal:			
Scrap do	199	47	All from United States.
Pig iron, ferroalloys, similar materials do	440	328	Australia 327.
Steel, primary forms do	558	356	Japan 351.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	729	r21	United Kingdom 11; France 4.
Universals, plates, sheets[2] do	1,520	214	West Germany 97; Italy 32; Spain 22.
Hoop and strip do	134	r52	West Germany 36; Italy 8.
Rails and accessories do	7	16	All to Japan.
Wire do	16	r6	Belgium-Luxembourg 4.
Tubes, pipes, fittings do	r721	873	West Germany 385; Japan 383.
Castings and forgings, rough do	(3)	(3)	All from France.
Other do	41	16	All to Poland.
Lead:			
Oxide and hydroxide value, thousands	$202	$212	Mainly from Australia.
Metal including alloys, unwrought	23,793	26,344	Peru 12,996; Canada 8,347; Australia 5,001.
Magnesium metal including alloys, unwrought	18	35	All from West Germany.
Manganese oxides	787	753	All from Japan.
Mercury	NA	10	All from Italy.
Nickel metal including alloys, all forms[2]	524	2	All from West Germany.
Platinum-group metals including alloys, all forms value, thousands	$947	$1,339	United Kingdom $654; West Germany $552.
Tin oxide	5	32	All from United Kingdom.
Titanium oxide	2,208	1,621	Japan 1,177; Italy 261.
Tungsten metal including alloys, all forms	1	10	All from Japan.
Zinc metal including alloys, all forms	NA	r3,999	Mainly from Peru.
Other:			
Base metals, n.e.s	5	19	All from United Kingdom.
Metalloids, n.e.s	NA	570	Italy 519; Yugoslavia 51.
Oxides of magnesium, barium, strontium	NA	100	All from Denmark.
NONMETALS			
Abrasives:			
Natural, n.e.s., grinding and polishing wheels and stones	r9	29	All from Japan.
Artificial corundum	92	269	United States 140; West Germany 87.
Asbestos, crude	160	335	All from Canada.
Cement	NA	76	All from France.
Clay products, refractory[2]	2,218	7,032	Japan 5,232; France 1,723.
Diamond:			
Gem, not set or strung value, thousands	$6,305	$2,929	Belgium-Luxembourg $1,515; United Kingdom $1,414.
Industrial do	$2,577	$2,177	Belgium-Luxembourg $2,138; Switzerland 29.
Fertilizer materials:			
Manufactured:			
Nitrogenous thousand tons	1,962	1,237	Japan 692; Netherlands 145; Poland 143; Belgium-Luxembourg 127.
Other, including mixed do	25	10	All from Belgium-Luxembourg.
Mica, crude or worked	3	14	All from United Kingdom.
Precious and semiprecious stones, except diamond natural value, thousands	$424	$208	Mostly from West Germany.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	1,708	14,868	Italy 14,048; Japan 500.
Caustic potash, sodic and potassic peroxides	NA	74	All from West Germany.
Sulfur, all forms	65,094	26,028	Canada 21,928; Japan 4,100.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	1,070	1,583	All from Japan.
Coal	0	241	Do.
Petroleum refinery products:			
Lubricants[2] thousand 42-gallon barrels	1	19	France 17.
Distillate fuel oil do	6	4	All from Yugoslavia.
Mineral jelly and wax do	(3)	(3)	NA.
Nonchemical coal, petroleum wastes do	1	r2	NA.

See footnotes at end of table.

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Table 3.—People's Republic of China: Apparent imports of selected mineral commodities[1] —Continued

(Metric tons, unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	5,319	13,493	All from West Germany.

[e]Estimated. NA Not available.
[1]Compiled from data of Australia, Belgium-Luxembourg, Canada, Denmark, Finland, France, West Germany, Hungary, Italy, Japan, Netherlands, Norway, Poland, Spain, Sweden, U.S.S.R., United Kingdom, United States, and Yugoslavia.
[2]Partial figure; tonnage not available for all sources.
[3]Less than 1/2 unit.

Source: For Hungary, Poland, and the U.S.S.R.—official trade statistics of the respective country; for all other countries—Statistical Office of the United Nations 1975 and 1976 Supplement to the World Trade Annual, v. 5 (the Far East), Walker and Co., New York, 1976, pp. 143-181.

COMMODITY REVIEW

METALS

Aluminum.—Because of the rapid build-up planned for the Chinese electrical industry and the anticipated expansion of the oil, gas, coal, and steel industries as well, demand for aluminum and copper should also increase sharply. Chinese aluminum output rose to at least 250,000 tons estimated for 1977. Recent additions to the aluminum capacity had been in the form of small plants of 20,000 to 30,000 tpy although China needs to construct a few large new plants. The only sizable aluminum plant that the country has was still the relatively old 100,000-tpy Fushun reduction plant in northeast China. Since aluminum reduction requires considerable electrical power in the process, the two industries must be built up at the same time.

More than a dozen locations have been mentioned as sites where small aluminum plants have been built, and it may be prudent to guess that only two-thirds of these have operating reduction facilities. The Sanmen Gorge plant in Honan-Shansi border and the Yiliang plant 80 kilometers southeast of Kunming have been described as having two lines of potlines each. Other unconfirmed plant locations are Lanchow in Kansu, Taiyuan in Shansi, Wuhan in Hupeh, Changling in Kirin, Tsingtao in Shantung, Chengtu in Szechuan, Hofei in Anhwei, and very recently Paotou in Inner Mongolia.

London's World Metal Statistics estimates that "western countries" exported 330,800 tons of aluminum to China in 1975, 133,700 tons in 1976, and only perhaps 25,000 tons (incomplete) during the first half of 1977. During 1976, the United States exported 37,350 metric tons of aluminum to China, and Japan exported 10,000 tons. In the first 10 months of 1977, U.S. aluminum exports to China were down to about 5,000 tons and Japanese exports rose to 29,000 tons. In September, Tokyo sources estimated that combined aluminum sales from five Japanese companies could total 100,000 tons for 1977, although international trade sources say that actual sales may have been only about 45,000 tons. It is clear, however, that the Japanese with large inventories were anxious to sell. Mitsubishi Light Metal was thinking about a 3- to 5-year contract for delivering 15,000 to 20,000 tons annually to China. For the world as a whole, known sales of aluminum to China may have been 150,000 to 160,000 tons during 1977, over 100,000 tons from the western countries excluding Japan. Some of the traditional suppliers were Alusuisse of Switzerland, Pechiney of France, and Alcan of Canada. According to trade sources again, China obtained relatively steady supplies of foreign aluminum throughout 1977. Also, it may be that the overall level approximates what China might need to import annually until its industrialization program accelerates.

Antimony.—China's output of antimony had been in excess of 10,000 tons per year (tpy) for many years and was perhaps 12,000 tons in 1977. Some feel the Chinese output of antimony had occasionally reached 15,000 tpy in recent years. About half of the Chinese antimony had been generally exported in recent years. However, international prices dropped to just over $1 per

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pound in early 1978 (recovered to $1.30 in April) and world demand was sluggish because of economic difficulties in many countries. Historically, China was by far the world's largest producer. The market for antimony for use in small arms and shrapnel shells had vanished many decades ago, but demand for use of batteries, bearings, type metal, solder, and standard munitions held firm and consumption in flame proofing, pigments, and ceramics became stronger. Bolivia with its complex metal ores, South Africa with its gold-antimony ores, and China were again the world's three leading antimony producers in 1977. Bolivia was trying to get the three together to talk about antimony and had itself recently sent several groups to China to discuss cooperation and exchange of information on antimony. At yearend 1977, Bolivia proposed a meeting of the three countries in La Paz during March 1978. Hitherto, South Africa has had technical problems (such as high arsenic) to resolve and it has not been particularly enthusiastic about conferring with the Chinese.

China's technical and commercial knowledge of this metal is excellent. The bulk of the Chinese antimony traditionally had come from the southwestern part of Hunan Province, headed by the Hsikwangshan mine, which may have had more than a million tons of mine antimony reserves by itself. Kwangtung Province ranked a distant second in potential and output. Under present low-price conditions coupled with the low demand, the antimony business is hardly attractive. However, overall resources are large enough to support any reasonable output level necessary to satisfy world and Chinese market requirements.

As usual, the Chinese tried to derive maximum benefit from antimony exports in 1977, selling more in periods of good prices and holding back when demand was low. There being no special production problem for Chinese antimony, surpluses were simply added to the stockpiles and shortages were made up from the stockpiles. Judging from recipient countries, Chinese exports of antimony were just over 5,000 metric tons in 1975, just under 5,500 tons in 1976, and very likely 5,000 to 6,000 tons again in 1977. The United States imported 191 metric tons of metal and 1,169 tons of oxide in 1976 and 438 tons of metal and 355 tons of oxide in 1977. The Japanese imported 819 metric tons of concentrates (analyzing 50% to 60% antimony) and 811 tons of metal in 1976 and 1,248 tons of concentrates and 1,133 tons of metal in 1977.

Copper.—Despite obvious mounting needs, the copper picture has not been clarified to any degree, partly because nonferrous metals are seldom reported. China probably still has copper stocks from previous imports, and the lull in basic construction and metal consumption, on account of recent difficulties politically and otherwise, has temporarily cut down on demand. There is no question, however, that the country can consume in excess of 300,000 tons of copper annually, of which not much more than half can be supplied domestically at the present time. Although little developed, the Chinese have recently claimed that their copper resources are substantial. Earlier reports noted that porphyry copper occurs in the Chilien Mountains of Kansu Province, the Chungtiao Mountains of Shansi Province, and in Chekiang Province. Current reports state that extensive high-grade skarn copper deposits have been found in the middle-lower reaches of the Yangtze River and "many other areas" as well.[14]

Photos of the modernized Tungchuan underground copper mine in Yunnan and the Tungling copper mine in Anhwei have been published in recent issues of the China Pictorial. A little earlier in the year, a large complex-metal copper deposit reportedly was discovered in the Tahungshan area of Yunnan Province.[15] An open pit copper mine near Tayeh, Hupeh Province, was said to be of both archeological and commercial interest. China apparently does not have a single big copper facility, and the largest mine is less than 20,000 tpy of mine copper in capacity. There is no news about the Shenyang and Shanghai smelters, which are old and only medium-sized at best. Small copper smelters and refineries have been mentioned for Lanchow in Kansu, Urumchi in Sinkiang, Taiyuan, Wuhan, Kunming, and in Anhwei Province and Hainan Island. Of great potential importance is a Chinese statement that a large copper refining facility would be bought from Japan in the near future, and the conjecture is that the Mitsubishi Metal Corp. will furnish this plant.

Chinese copper imports averaged about 100,000 metric tons annually during 1973-74. In 1975-77, yearly imports were closer to 30,000 to 40,000 tons, not counting what might have been bartered. Despite very low prices, China had not resumed large-scale

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copper purchases as of late 1977. The Chinese had made a bold bid to consolidate and expand copper supplies from Africa by handing over the 1,100-mile Tanzam Railway they built, in the presence of the Presidents of Tanzania, Zambia, Zaire, and Botswana in July 1976. They have a long-term contract to obtain 50,000 tons of mine copper per year from Zambia, but open market statistics have not confirmed such a high level. The Chileans exported an average of more than 45,000 metric tons of copper to China yearly during 1972-74, but tonnages became uncertain for subsequent years because of Chile's political changes. However, to repay a Chinese loan, the bartered tonnage by Chile would still be at least 25,000 tons yearly. In helping to develop the Tintaya mine in Peru, the Chinese were scheduled to be repaid by about 40,000 tons of copper annually plus 10,000 tons each of lead and zinc; these tonnages are a little higher than that actually transpired. Papua's Bougainville mine supplied China with a 10,000-ton shipment of copper concentrates in early 1976, and negotiations were underway to obtain additional tonnages. However, Chinese copper imports from the Philippines might well expand, in view of Chinese interest in selling crude oil. With the November 1977 contract by Atlas Consolidated to supply China with 40,000 tons of copper concentrates valued at $12 million, total such exports by the Philippines from their start in 1975 had reached $36 million.

Iron and Steel.—After suffering a severe setback during 1975-76, the Chinese steel industry staged a strong comeback in 1977. Much was said about the improved performance of the steel industry during the latter year; beginning in the spring of 1977, production showed great increase and, in many cases, established records. The turnaround forshadowed a successful year in 1978 when production could conceivably exceed 30 million tons per year for the first time in China's history.

Recognizing that steel output must be pushed up sharply to meet industrial needs in the years ahead, the Chinese have set the long-range target of surpassing U.S. levels by the end of the century. Even by the early 1980's, plans underway indicate that China's steel production can reach the 40-million-ton annual level, and by 1985 the hope is to produce 60 million tons. Various developments point to these probabilities. A hematite iron ore beneficiation mission visiting the United States in mid-1977 indicated that Chinese planners intend to start large-scale development of the extensive low-grade iron deposits in the north. Chinese technical steel missions were sent to Japan and Western Europe late in the year. Japanese steel trade missions have visited China on many occasions. In 1977, inquiries were made of the presidents of Nippon Steel and Sumitomo Metal Industries to build 6-million-tpy steel facilities. Interest is growing in constructing large blast furnaces and basic oxygen converters. China already buys high-grade iron ore from Australia and has recently been negotiating with the Brazilians for supplies. In January 1978, Tokyo reported that the Japanese had been asked to help construct 20 large integrated steelworks in China to help meet end-of-the-century long-range targets.[16]

Japan has been China's leading steel supplier by far, sending about 2.9 million tons of products to China in 1974; 2.8 million tons in 1975; and 3.5 million tons in 1976. China purchased approximately 4.8 million tons of steel from Japan for shipment during April 1977 to March 1978. West Germany probably ranks a distant second to Japan in supplying finished steel to China in recent years, and there are 10 other countries that furnish 20,000 to 70,000 tons annually. China has imported 300,000 to 700,000 tons of scrap annually in the 1970's (mainly from the United States), and 300,000 to 500,000 tons of pig iron annually in recent years (mainly from Australia). During 1974-76, China's imports of iron ore have averaged nearly 3 million tons per year, roughly half each from Australia and North Korea.

Although large steelworks provide the bulk of China's production, the role of medium and small plants has been much more significant than in other major countries in the world. Medium and small steelworks have together provided one-fourth to one-third of China's total steel output in recent years. A current article gives some insights.[17] A rapid growth of this sector was claimed for 1958-60, followed by a very severe cutback the next 5 years. A new buildup took place during 1966-72, and output in 1973 reached high levels. However, production in the 3 years 1974-76 added together was said to be not as much as the quantity produced in 1973. There was a turnaround in 1977. Each of 10-odd Provinces and Special Districts (including Kiangsu, Shantung, Honan, Hopeh,

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Kwangtung, Liaoning, and Anhwei) reportedly produced more steel than the national total before Liberation. In 1977, there were a total of more than 50 steelworks of 50,000-tpy capacity in existence or being constructed and over 500 smaller steel plants spread out in the country. Actually, a number of the medium-sized plants have annual capacities of hundreds of thousand tons.

The future of Anshan, China's leading steelworks by far, looked bright once more at yearend 1977, especially when compared with the miserable performance in 1976 when output was much below the 6- to 7-million-tpy steel ingot capacity. Production reportedly increased from month to month beginning in the spring of 1977 until records were claimed in the winter months. The most interesting news concerning Anshan was reports by officials of Nippon Steel regarding their talks with the Chinese about doubling Anshan's capacity in 3 years, to roughly 12 million metric tons of steel products annually.[18] Chinese intentions seem serious, although time schedules discussed may not be quite realistic. In pig iron, the plan would be to import 13 or 14 large blast furnaces to replace the smaller ones now in use and rebuild some existing bigger blast furnaces. In steelmaking, the plan would be to replace old open-hearth furnaces with large size, top blown oxygen converters.

The overall program to rebuild Anshan would be patterned after the reconstruction program of Japan's Yawata Steelworks. New equipment for pretreatment of raw materials would also be installed, no doubt along with fabrication facilities. Anshan's last or 12th blast furnace—2,580 cubic meters and capable of producing 1.5 million tons of pig iron annually—was blown in on December 29, 1977. Reportedly, China was combining two blast furnaces into one at Anshan so as to make the new furnace "the country's largest";[19] this may be the furnace mentioned above. Anshan's No. 11 of 1,000 cubic meters started operations in 1972; its only other sizable blast furnace is rated at 1,513 cubic meters, and the smallest one seems to be 585 cubic meters in size. The world's and Japan's largest blast furnace is about 5,000 cubic meters, but what was discussed with the Chinese was probably smaller. Anshan had about 25 open-hearth furnaces and two 120-ton basic oxygen furnaces (BOF); it is quite likely that the Chinese are thinking about installing the necessary number of 100- to 150-ton BOF's within the next 5 years, so as to produce 12 million tons of steel products. Anshan has mostly 4-cubic-meter electric shovels and 20-ton trucks at the open pit mines now, and it will need larger size equipment for expanded output.

The Peking, "Capital," or Shihchingshan steelworks apparently has done reasonably well in recent years.[20] With two blast furnaces of 1,000 to 1,200 cubic meters and two smaller ones, the Peking steelworks has had the capacity to produce about 2 million tons of pig iron yearly for some time. However, its No. 2 sintering plant and its No. 4 coke plant apparently had not been completed until late in 1977. Since steel output reportedly has been raised fivefold in the last decade, Peking's current yearly steel capacity may be close to pig iron capacity. Thus, Peking has become an important integrated steelworks, with ferroalloys, refractories, cast iron, and nonferrous facilities as well. Details on steel making and rolling facilities are not known, although this complex certainly has open-hearth furnaces, oxygen converters, and a blooming mill. Currently, iron ore comes from the Lungyen and Chienan mines which are located within an iron range with extensive low-grade ores. The Peking steelworks of the future could be streamlined with new equipment and considerably expanded in the process. The Japanese steel firm Nippon Kokan apparently has been asked to help renovate and expand this steel center to as much as 6 million tpy.

The integrated Wuhan steelworks is capable of producing more than 2.5 million tons of steel ingot per year. However, during all of 1976 and possibly half of 1977, this plant has had serious political difficulties which had the net effect of greatly slowing down production. It was not until early October 1977 when daily steel and pig iron production were restored to 6,000 metric tons and 7,300 metric tons, respectively. Wuhan has four 1,400- to 2,000-cubic-meter blast furnaces, four byproduct coke plants (the last one completed around May 1977), eight mostly 500-ton open-hearth furnaces, a hot rolling mill, a plate mill, and a rail mill. Very possibly, Wuhan will soon be building large BOF's to complement or replace the open hearths. West German and Japanese fabrication equipment worth $550 million, including a 3-million-ton hot strip mill, a 70,000-ton silicon Sendzimer steel mill, a million-ton cold strip mill, and a continuous casting mill, were in the process of being

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installed, although startup may be delayed until 1979. Wuhan has at least four iron mines, including the Tayeh open pit and the Chengchai and Tahungshan underground mines.

Shanghai with possibly eight small steelworks and an aggregate annual ingot capacity of considerably more than 3 million tons also has had operational difficulties in recent years, although not as severe as Wuhan and Taiyuan. However, the situation in Shanghai had returned to normal by the second half of 1977. During the first 10 days of January 1978, Shanghai's daily steel output reportedly averaged 13,700 metric tons. In early 1978, several Japanese newspapers reported that Nippon Steel, aided by other Japanese steel producers, will help build a 6-million-tpy steelworks in the Shanghai area for completion in the mid-1980's at a cost variously estimated at $1 to $2 billion in terms of foreign exchange. It is highly probable that much of the basic raw materials needed will be imported.

The Taiyuan steelworks, rated at just over a million tons of annual steel capacity and possessing China's only foreign-built BOF (Austrian, 55 tonners), had been worked haphazardly until late 1977. The largest of Taiyuan's four blast furnaces is rated at 1,200 cubic meters with another one close to 1,000 cubic meters in size; these furnaces together seem to be capable of producing over 2 million tons of pig iron yearly. A new large open pit iron mine called Okou altogher with a beneficiation plant were brought into production in early 1977 to supply Taiyuan. The Paotou steelworks in Inner Mongolia has added a third large blast furnace; the first one built was 1,513 cubic meters in capacity. The Penhsi (Penchi) steelworks in southern Liaoning Province, originally rated at about 1.5 million tpy of pig iron capacity, has been built up into an integrated steelworks. The last coke oven plant (65 slots) was completed by mid-1976. Penhsi's No. 2 steel plant, whose construction began in 1972, started operations on August 6, 1977; among its facilities are "large" oxygen top blown converters built by Chinese engineers. Substantial espansion of Penhsi with the help of the Japanese may also be in the works.

Tin.—Very little new information came out of China on tin. However, exports were clearly down, judging from reported imports by consuming countries. A reasonable guess is that total Chinese tin exports dropped from nearly 15,000 tons in 1975 (highest tonnage for more than a decade) to 7,000 tons in 1976 and only 3,000 tons in 1977. Correspondingly, U.S. imports of tin from China declined from nearly 6,400 tons in 1975 to just over 1,700 tons in 1976, and probably less than 400 tons in 1977. During the last 5 years, the Billiton subsidiary of Dutch Shell handled a large part of Chinese tin exports worldwide. Some of the 1974-75 period Chinese tin reaching international markets was old tin, whereas more recent exports were mostly high-grade new tin. The Soviet Union no longer obtains much tin from China, but Finland became a purchaser of possibly 400 tons in 1977. For whatever reasons, the Chinese have not been selling much tin.

Some people feel that production is down from the generally estimated 20,000-tpy annual level. It is clear that consumption has been increasing steadily during the seventies, except for 1976. This trend should continue, and in fact, probably will rise to a higher plateau by the early 1980's. Even now, consumption of tin in China may be pushing 10,000 tpy. The 120,000-tpy ETL tinning plant at Wuhan, which would consume about 600 tpy of tin, will soon be in operation; China probably had been saving some tin for this plant rather than exporting it. Unconfirmed reports say that Mitsui people are helping the Chinese to build tinning facilities in north China that may need thousands of tons of tin per year. More important is that China is planning to build various large steelworks within 5 years, and no doubt these will have tinning lines. Thus, unless China finds and produces more tin in the future, there could well be a shortage.

Chinese tin reserves are undoubtedly large by world standards, and generally credited at 1 to 2 million tons of tin content. The most important tin center is still Kuchiu in Yunnan, which had been renovated in the late 1950's and modernized in the early 1970's. The lode tin ore is high grade but contains impurities; product quality has been recently improved which implies addition of better refining facilities. It is not known whether the earthquake in Yunnan during 1976 affected Kuchou's operations. China's No. 2 tin center is the general district of Fuhochung in Kwangsi Province, which is placer and has clean tin. The placers are 1 to 5 meters thick and probably occur in narrow river plains. A new placer district in Kwangsi is Chiumou. The relatively new districts of Haifeng and

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Chaoan in Kwangtung Province are said to have reserves of over 200,000 tons of tin each. A tin mine called Pantan was reported for Kwangtun, producing about 10 kinds of "rare" metals as byproducts.

Tungsten.—China's tungsten resources are probably the largest in the world, and overall reserves may be about 100 million tons of 1.0% to 2.5% WO_3 ore, as an order of magnitude. Consumption has steadily grown to the present level of 5,000 to 6,000 tons of concentrates and exports have ranged from about 25,000 tpy of concentrates in the early 1960's to 12,000 tons in 1973 and perhaps 6,000 tons in 1977. However, output does not vary according to domestic consumption and exports, since management of production and sales are under separate groups. For a country very much aware of national security matters, China could easily have 50,000 tons of stocks. If China builds up its steel industry as announced and does not find new large resources, then exports might well decline further. World prices were good ($130 per short ton unit or 10 pounds of WO_3) in late February 1978, but exports remained low. China participates in United Nations Conference on Trade and Development and Primary Tungsten Producers Association meetings in Geneva but have thus far said very little about its tungsten industry.

Most Chinese ore is high-grade wolframite from Kiangsi Province, but scheelite from Hunan Province has become important, and significant deposits have also been found elsewhere in southeast China, particularly in Kwangtung Province. There are probably a dozen mines capable of producing 500 to 2,000 tons of concentrates annually as well as many other smaller mines in the "tungsten belt" along the Nan Ling Range. The best known mines in Kiangsi are Hsihuashan, Tachisan, Kweimeishan, and Pankushan. Considerable exploration has been done in recent years on the known deposits of Kiangsi, including use of modern geophysical methods and study of the correlation of tungsten mineralization with tectonic systems; apparently, many hidden ore bodies have been discovered which helped to rejuvenate the tungsten mines in this Province.

A typical large Kiangsi mine in the Tayu district has hundreds of steep veinlets in a mineralized zone of several square kilometers, with reserves of possibly 100,000 tons of WO_3 contained in ores analyzing 1.2% WO_3 and 0.5% tin, and it generally produces 100 to 1,000 tpy of finished tungsten concentrates. Mining at 100- to 250-meter depths is well engineered and at least semimechanized, with daily ore production in the 2,000-ton range. Hunan mines are best known for scheelite and one of these may be Yangchiatan. However, small wolfram mines located in Tucheng County of this Province apparently were doing well. Three better known mines in Kwangtung are Yangchiang, Shihjenchang, and Yaoling, probably all producing wolframite. Most Chinese tungsten ore entering the world market is medium high-grade wolframite analyzing 65% WO_3 plus. The small amounts of scheelite sold are of medium grade in impurities.

NONMETALS

Asbestos.—Although China's known asbestos consumption is still unaccountably small for a country rapidly gaining in industrial stature, demand for asbestos products should reach significant levels in the coming decade. China, in producing 150,000 to 200,000 tpy of good quality asbestos, has already become a moderate-sized world producer. The famous asbestos town of Shihmien (which means "asbestos" in Chinese) in Szechuan, with its reasonably up-to-date beneficiation mill, powerplant, and aerial tramway and an ore zone 4 miles long by a quarter of a mile wide containing very long-fiber chrysotile asbestos, dominated the country's asbestos scene. However, a second major asbestos deposit located at Penghsien near Shihmien no doubt will also become important.

Chinese asbestos deposits are found in a belt from Kirin and Liaoning Provinces to Southwest China (including Szechuan), passing through Hopeh, Shensi, and Inner Mongolia. Laiyuan in Hopeh Province and Chinhsien in Liaoning Province are leading producers of lower grade asbestos. No recent news has been available on the recently found Yuankiang deposit in Yunnan Province. China also has considerable amphibole asbestos.

Barite.—Chinese barite is coming to the forefront of mineral activity in view of the growing domestic market created by extensive drilling for oil and gas. Output in 1977 is estimated at possibly 300,000 tons (roughly 7% of the world total) and should continue to rise. Exports peaked at 125,000 tons in 1974. A recent offer to sell large tonnages of Chinese barite to the United States came to no avail. Chinese barite is produced in three grades—90%, 95%, and 97%.

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China seems to have extensive barite resources, although current production areas are not known. Old deposits include Tangshan in Hopeh, Hwashan in Shantung, Hsuijen in Kwangsi, and Linchuan in Kiangsi. All barite deposits mentioned hitherto seem to have high-quality, easy-to-work ore bodies, with implications of initial reserves at millions of tons.

Cement.—China's cement industry continued to expand, with production exceeding 40 million tons in 1977. This ranked China fourth in the world, behind the Soviet Union, Japan, the United States, and just ahead of West Germany. More than half of the cement produced in the country, and perhaps as much as three-fifths, was furnished by small cement works, which reportedly raised output by about one-fifth over that of 1976,[21] as compared with 7% a year earlier. Apparently, large cement plants did not make too significant gains.

Little has been reported on the 30-odd large cement works (200,000 tpy or larger), which are scattered around in most of the industrial or population centers. Four plants are known to be rated at close to 1 million tpy, and a fifth one probably had recently been completed by the French. The earthquake-destroyed Tangshan cement works has not only been rebuilt but most likely expanded as well. The Talien (Dairen or Luta) plant in Liaoning Province no doubt had undergone modernization and expansion. An interesting news item concerns the Kwangchow cement works in Kwangtung Province,[22] with four rotary and two vertical kilns and formerly rated at 700,000 tpy. To correct its air pollution problem and to improve efficiency by recovering more fines and making byproduct potassium fertilizers, this plant was able to raise output by about 52,000 tpy and save 1,000 tpy of fine coal in the process. China also has 30 to 40 cement plants of 100,000 to 200,000 tpy. In view of its intention to accelerate industrial development, China probably will embark on a program to build more large plants (including suspension preheaters) both by their own efforts and with foreign help.

Nonetheless, the small-plant sector, which already has played a very significant role, probably will remain important in the scheme of things. China has well over 3,000 small cement plants of 3,000- to 5,000- and 10,000- to 50,000-ton sizes. The trend would be to eliminate the smallest ones and expand their larger counterparts whenever possible. Shantung Province with an output of nearly 3 million tpy leads China's Provinces in small-plant production, followed by Honan and then by Kwangtung, which possibly produces 1.5 million tpy. Small cement plants are in Provinces like Szechuan, Shansi, Hopeh, Hunan, Shensi, Kiangsu, Kiangsi, Liaoning, Kirin, Yunnan, Kweichow, Inner Mongolia, Sinkiang, and Tsighai. All told, China most likely has hundreds of cement plants producing tens of thousands of tons each. One such small plant, located in Pingshiang, Kiangsi Province, has been expanded to 100,000 tpy. As examples, 30,000-tpy-size plants have been recently built in Hsinglung County (two there) in Hopeh Province and Tungchuan County in Yunnan Province.

Diamond.—With more hard-rock exploration underway and the need to obtain more cores and samples even in oil and gas drilling, requirements for industrial diamonds have increased sharply in recent years. The best known diamond mine is located at Changte in the Province of Hunan. The exact location of a very important new diamond deposit in Liaoning Province is still not known. Unconfirmed reports indicate that natural deposits have also been discovered in Kweichow and Shantung Provinces. China has more than a dozen synthetic diamond plants, but the quality of the diamonds made does not appear to be totally satisfactory in grain size and strength. Nonetheless it was said that synthetic diamond bits have been successfully used to drill China's deepest producing oil and gas hole of 7,058 meters, in Szechuan.

Fertilizers (Mainly Nitrogenous).—Very significant progress was officially reported for fertilizer production in China during 1977.[23] The overall target for chemical fertilizers was achieved 21 days ahead of schedule, and output (probably combined gross tonnage) was said to be 31.9% higher than the historical peak attained in 1975 for the same period of time (presumably 344 days). Specific production gains for the first 11 months were 38.3% for synthetic ammonia, 42.7% for nitrogenous fertilizers, and 18.1% for phosphatic fertilizers.

Almost all the Provinces and special districts topped their 1976 production, including Shantung, Szechuan, Hopeh, Honan, Kweichow, and Shansi, which attained their quotas 34 to 72 days ahead of schedule. Shantung was the leading nitrogenous fertilizer-producing province with over 120 small plants and two large plants. Produc-

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tion increases were noted for each of the quarters of 1977. It was admitted that the original targets for 1977, as projected in 1974, were not quite fulfilled. Nonetheless, output levels were significant by world standards. Plans being implemented and construction already underway would roughly double Chinese production within 3 years. Moreover, the Chinese are expanding indigenous production across the board (with considerable stress on smaller plants), and apparently asking for bids for additional large foreign plants (unconfirmed). Although nitrogenous fertilizers are of primary importance, phosphate development is progressing rapidly, and there are clear signs that potassium fertilizers will be carefully investigated as well.

China probably produced close to 4 million tons of contained nitrogen (N) in 1977. Not counting the 13 new large foreign plants purchased in 1973, all to be placed in operations by 1979, China still has about a dozen other sizable nitrogenous fertilizer plants and over 1,200 small- and medium-sized nitrogenous plants scattered around the country; during 1975 the latter smaller plants reportedly produced over half of the country's total output of synthetic ammonia. A typical small plant produces 3,000 to 5,000 tpy of aqueous ammonia or ammonium bicarbonate, and medium-sized plants may produce 50,000 to 100,000 tpy. China built its first 200,000-tpy-size reactor for urea production at the Harbin Boiler Works in late 1977.[24]

Of the 13 complexes or "whole plants" purchased, 8 are being handled directly by Pullman-Kellogg Co. and its Dutch subsidiary. The 1,000-tpy-ammonia units are based upon Kellogg's own process, while the 1,620-tpy-urea units are based upon the Stamicarbon stripping process. Two other plants with nearly similar size units and having Kellogg ammonia equipment have been completed by Mitsui-Toyo Engineering, location unknown. The remaining three facilities were awarded to the French-owned Heurtey Industries, with units based upon the Haldor Topsoe ammonia process and the Stamicarbon urea process. Heurtey's plants are located at Nanking west of Shanghai, Canton (Kwangchow) near Hong Kong, and Anching 700 kilometers upstream on the Yangtze River from Shanghai. The eight Kellog plants are located in the Provinces of Heilungkiang (at Wolitun within the Taching oilfield), Szechuan (near Luchow within the gasfields), Hopeh (near Chengchow), Liaoning (at Panchin near Shenyang), Yunnan (possibly near Kunming), Hunan, Hupeh, and Kweichow. The 13 plants all told can produce a total of nearly 7 million tons of urea equivalent or 3.4 million tons of contained nitrogen. It has been rumored that the Chinese were asking Kellogg to bid on 11 new coal-fired ammonia plants.

Specific news has been available on some of the larger plants. The Heurtey plant in Kwangchow within a petrochemical complex was capable of producing 1.4 million tpy of various nitrogenous fertilizers, as of mid-1977. The Taching Kellogg plant[25] in Keilungkiang and the Luchow Kellogg plant in Szechuan, both also within petrochemical complexes and rated at more than 1 million tpy of finished products each, went through their first major overhauls late in the year. The Kellogg plant in Hopeh is of the same size as the two above and was also placed in operation during 1977. The fourth and latest (February 1978) Kellogg plant to go onstream was the one in Yunnan which probably uses natural gas piped in from Szechuan. The Peking oil refinery and petrochemical complex also has a large nitrogenous fertilizer plant. Two other fairly large plants have been newly completed—one in Hochih in Kwangsi Province and one in Ulashan in Inner Mongolia.

Despite efforts to increase production, China continued to be by far the largest importer of nitrogenous fertilizers in the world. The tonnage purchased for delivery in the second half of 1977 were as follows:[26] Urea—Japan 542,000, Nitrex 250,000, Indonesia 100,000, Iraq 100,000, and Kuwait 100,000; compounds—Complexport 300,000, Spain 50,000, and Greece 40,000; ammonium sulfate from Japan 150,000; and ammonium chloride from Japan 270,000 tons. For 1977 as a whole, Japan exported 926,477 tons of urea, 631,800 tons of ammonium sulfate, and 348,900 tons of ammonium chloride to China.

Fluorspar.—China has been an important producer and exporter of fluorspar for several decades, and output in 1977 probably exceeded 350,000 metric tons. A large surplus has been traditionally exported, mainly to Japan, which took 117,115 metric tons in 1976 and 111,147 tons in 1977. However, Japan's overall steelmaking requirements for fluorspar continued to decline on a per-ton-of-steel basis, and its steel industry prefers Kenya metspar to the lower grade Chinese metspar. The U.S.S.R.

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took 84,840 tons in 1974 and 55,047 tons in 1975 (no later reporting of this nature by the Soviets). Poland generally imports 10,000 to 15,000 tons of Chinese fluorspar annually. Most fluorspar is metallurgical grade, but a significant share of the output is acidspar. Very high-grade lump fluorspar was trial shipped to the U.S. market in mid-1976, but high shipping costs and duty ($8.40 per long ton for metspar and $2.10 for acidspar) here illustrate the difficulty of selling in distant markets. Up to 100,000 tons of fluorspar were consumed in China during 1977, including at least 50,000 tons by the steel industry and 20,000 tons by the aluminum industry. China was becoming interested in hydrofluoric acid. China's annual fluorspar demand should reach the 200,000-ton level within a decade.

Historically, the leading producing districts have been Wuyi in Chekiang Province, Kaiping in Liaoning Province, and Lung-hua in Jehol Province. Fluorspar has also been mined in Shantung and Kwangtung Provinces. A new producer has come into prominence in recent years, namely the Taoling mine in Hunan Province, which is also a lead-zinc producer. Taoling has flotation cells and probably produces over 80,000 tons of acid-grade fluorspar annually. Another recently developed fluorspar producer is located in Pecheng County, Fukien Province. Fluorspar might well be found in many tin-barren granite ranges in China, if carefully explored.

Phosphates.—China's phosphate deposits seem to be widespread in the eastern third of the country. Reserves undoubtedly are large, and the Chinese are making good use of the uneven and often poor-grade ores. Earlier discoveries were mostly near the Burma border, particularly the Kunming and Kunyang areas of Yunnan Province, although a big high-grade phosphate rock deposit was found in Yunnan in 1977. More recently, workable deposits were also found and worked in the Kaiyang region of Kweichow, the Tau River area of Szechuan, the Foshan area of Kwangtung, the Liuyang-Huachiao area of Hunan, the Chinghsiang area of Hupeh, and the Chaoyanglin area of Kiangsi. There seem to be sizable mines in Kweichow, Hupeh, and Kiangsi Provinces. Shantung Province with its many small mines has emerged as the leading producer of phosphates during the last few years. Very recently, a sizable deposit of phosphate rock was discovered in the North China Province of Hopeh around Fanshan. Reportedly, a phosphate shale mine has started operations in Northeast China's Kirin Province within the county of Changpai. By raising annual production of phosphate rock to possibly 4 million tons, China has cut down on imports from countries like Morocco and Vietnam to very small tonnages from 2 million tpy several years ago.

China's small phosphate plants, which may total over 1,500 in number, account for as much as three-quarters of the country's output of chemical phosphates. Shantung has nearly a third of these plants. In order to supply the necessary raw materials, about 150 phosphate rock and sulfur mines spread out in 59 counties[27] had been built in Shantung as of May 1977 and 90 more had been designed or were under construction. Since 1975 alone, the Shantung Geological Survey had located over 300 phosphate sites and 37 pyrite sites within the Province. Kwangtung Province claims two dozen small phosphate fertilizer plants, capable of producing a total of more than one-half million tons of compound fertilizers. Relatively large superphosphate plants that have been mentioned in the press include Nanking, Changsha in Hunan, Hunghochou in Yunnan, Shanghai, Taiyuan in Shansi, Kwangchow and Chanchiang in Kwangtung, and Yingtan and Tunghsiang in Kiangsi. The Chinese have started to use spent shales, cement plant wastes, slags, and boiler ashes for fertilizer raw materials.

Potash.—China has not yet examined its potash resources to any great extent and does not use much of this fertilizer ingredient. Thus, production and imports are both low, and there is no indication that any sizable natural potash deposit has been found so far. However, interest is growing, judging from the fact that potash is being recovered from saline operations, sedimentary rocks, and various waste materials. While it is too early to estimate tonnages, sea salt works at various locations such as Tangku near Tientsin and Luta in Liaoning and brine works in the Tzukung (or Tzuliuching) area of Szechuan are known to recover potassium chloride.

The first important mention of potash in the Chinese press was in connection with the Chaerha salt lake works in the Tsaidam Basin, where reportedly a new technique was developed to recover byproduct potash; as a result, output of this plant was raised twentyfold in the decade ending 1976. The

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Shantung Geological Survey was prospecting for potash along with phosphates and pyrites. Apparently, potash occurs at depth and this makes it difficult for small-scale operations. Shantung's geologists, however, incidentally found a sizable zeolite deposit which may be useful in recovering potash from seawater.[28] The large Kwangchow cement works started to recover more kiln dust, which was converted to potassium fertilizers. Elsewhere in Kwangtung Province, about 27 plants were capable of producing 150,000 tons of potassium calcium fertilizers annually and 24 other plants were capable of producing 600,000 tons of phosphate-potash fertilizers.[29] Small potash and phosphate plants were also operating in Szechuan Province, and certain coal-fired thermal plants were making byproduct fertilizers from the ashes.

Pyrites.—China has been an important world producer of pyrites for some time and annual output is at least 2 million tons. Previously known are two large pyrite mines—Hsiangshan in Anhwei and Yingte in Kwangtung. Also, pyrite in Szechuan Province has been made into sulfur, and sizable tonnages of pyrite are being mined in Shantung Province. Late in 1977, a selenium-bearing, probably cupriferrous-pyrite mine was reportedly found somewhere in Kwangtung Province.[30] In early 1978 it was reported that China's largest pyrite mine was being built in the Yunfu area of Kwangtung; construction at this open pit mine had already been half completed, including facilities like railroad, docks, water reservoir, and powerplant.[31]

Salt.—China in producing an estimated 35 million metric tons of plain salt in 1977 was approaching the production level of the United States, the world's largest producer. However, unlike the United States, where most of the salt produced is rock or brine salt, China extracts 80% to 90% of its edible salt by solar evaporation in wind-protected shallow bay areas along the coast. A large part of Chinese salt is for food purposes, but a growing proportion is being consumed for industrial purpose. It was claimed that China's 1977 salt target was fulfilled 110 days ahead of schedule, that the tonnage was a historical record, and that the general quality was excellent and production costs low.[32] The Tangku salt field, after the salt pans damaged by the Tangshan earthquake were quickly repaired, reportedly overfulfilled its 1977 output quota. Kwangtung Province apparently produced 75% more salt in the first 9 months of 1977 than during the same period a year earlier; its largest fields Yinkou and Hainan Island both attained their full year's targets near the half-year mark. Shantung, another important sea salt-producing Province, established a production record. Kwangsi Province also met its 1977 goal and produced at record levels despite inundation difficulties.

Inland, Szechuan Province with its famous salt brines (and natural gas to evaporate the brines) from the Tzuliuching area produces just over 5% of China's salt. Kiangsi Province has a sizable rock salt mine and salt works at Chingkangshan. Ninghsia Province has developed an inland salt field called Chilantai. Sinkiang with its biggest saltworks at Chichiaching in Hami District now produces enough salt for its 15 million people. China has hardly touched the large potential salt resources associated with the oil and gas fields. Various areas described below produce plain salt along with other salts.

China's production of other kinds of industrial salts has also made significant progress, along with basic investigations as to their origin, availability, and extraction problems. The Tsinghai (Chinghai) Salt Lake Institute of the Chinese Academy of Sciences has recently completed a survey of more than a thousand salt lakes in the Tsinghai-Tibet Plateau which together represent half the dry, semidry, and salty lakes in the entire country.[33] Two important scientific books were published on this general subject. One is entitled "Salt Lakes of the Tsaidam Basin," which provides good scientific guidelines to exploration for new saline sedimentary beds. The second is called "Methods for Analyzing Brine and Salts," which evaluates the chemical and physical properties of the pertinent minerals and elements.

Reportedly, a new process was devised for extracting carnallite from the Chaerhan Salt Lake in the Tsaidam Basin, based upon the "daily salt separation (crystallization) quota." A new technique for making potassium fertilizer was also developed at the Chaerhan works, which enabled potassium fertilizer output to increase twentyfold during 1966-76. Moreover, a method to extract boric acid directly from the borates obtained from Chaerhan's mixed salts, through the use of sulfur dioxide, was introduced.

A description of the over-three-thousand-year-old Yuncheng inland salt field (semi-

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dry lake deposit), located in the southwestern part of Shansi Province, appeared in the press.[34] This salt field is 20 to 30 kilometers long and 3 to 5 kilometers wide. It is a complex salts storehouse, much like Searles Lake in California. Aside from large tonnages of sodium sulfate, sodium chloride (edible salt), magnesium sulfate, and calcium sulfate (gypsum), there are many kinds of lesser minerals and elements such as bromine, iodine, potassium (potash), borates, lithium, and many "rare" elements. Whereas only edible salt was produced historically, Yuncheng has now been modernized into a chemical raw material base with sodium sulfate as the foremost product. The degree of mechanization has steadily increased, output has been continually expanded, and a greater variety of products has been manufactured, including dehydrated sodium sulfate, sodium chloride, sodium silicate, and bromides, etc.

A large deposit of high-grade natural soda reportedly has been found in Tungpai County of Honan Province, within the Paleogene system of Cenozoic rocks. Previously, such minerals were found only in saline lakes of the Quaternary era.[35]

MINERAL FUELS

Coal.—The Chinese have informed certain foreign visitors that their 1976 coal output was in excess of 480 million tons; also, it was suggested that the production in 1977 was about 10% higher. Thus, China's total 1977 output of marketable coal can be conservatively estimated at 500 million metric tons. Specific claims for 1977 noted that the national target for raw coal production had been achieved 28 days ahead of schedule (output increase was 10.2% compared with the same period last year); target for the key or major coal mines, 12 days ahead of schedule (output increase was 8% compared with the same period last year); national target for washed coal, 25 days ahead of schedule; and the geological prospecting plan, 51 days ahead of schedule.[36] An important National Conference of Coal Mining and Tunneling Teams took place in November 1976, followed by another National Conference in January 1977 which Chairman Hua Kuo-Feng himself attended. A western article described China's "grand plan for coal" and the status of coal extraction practice and equipment there.[37]

Many existing mines and combines reported great increases in extraction rates in 1977, no doubt in part compensating for the relatively low output levels a year earlier when political difficulties hampered operations.

Fifty pairs of large coal shafts were completed in 1975, and 42 pairs of large coal shafts were placed in operation in 1977.[38] The Chinese started to use considerable "stone coal" (bone or shale coal) for power generation.

Coal production in Chiangnan (which means south of the Yangtze River and embraces the Provinces of Kiangsu, Chekiang, Anhwei, Kiangsi, Fukien Hunan, Hupeh, Kwangtung, and Kwangsi) continued to increase, perhaps to about 140 million metric tons. The degree of self-sufficiency in coal of this area had risen to more than 70%, which means that proportionately less coal needed to be shipped from the north. The Chiangnan coalfields basically have been developed since 1965 when there was only one large combine—Huainan in Anhwei, which is the leading coal-producing Province of the south. Now, there is a second large coal combine in Anhwei, namely Huaipei, which has not yet reached full production. Combined output of Huainan and Huaipei was well over 20 million tons of marketable coal in 1977. Recently, a third large coalfield, called Linhuan, was discovered in Anhwei, Su Hsien, reportedly with three times the reserves of Huaipei.[39] Apparently the country's small- and medium-sized mines provided about a fourth of the national output in 1977. Many of these mines are down south, but there is also tributary output of small mines in the north, as is the case of Shansi Province.

Kailan combine's 1977 raw coal output was approximately half of the peak level of 25 million tons achieved in 1975, although it was claimed at yearend 1977 that pre-quake daily production rates had been reestablished. Aside from pumping out 160,000,000 tons of water and rebuilding all shafts at Kailan's seven mines, about 370 kilometers of roadways were restored, a hundred-odd coal working faces were developed for production, and over 33,000 units of equipment were rebuilt.[40] The Luchiatun colliery was the first to be fully operative and its 1977 output was brought up to more than 2.5 million tons. The Chaokochuang colliery was aiming at similar tonnage for the year, and topped the 20,000-ton-per-day (tpd) level in mid-December. At the Linhsi colliery, all of the 80-odd "integrated mechanized hydraulic support systems" were brought back into production. The Fankochuang colliery,

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with six coal seams and many kinds of working conditions, was made into one of China's most mechanized coal mines with output capacity brought up to about 4 million tpy. The best coal brigade at Fankochuang established a national output record of nearly three-quarters of a million tons of coal per year. Kailan produces at least 3 million tons of coal annually by hydraulic mining methods.

Shansi Province, which is virtually underlain by coal and producing about a sixth of China's total coal, continued to do well in its effort to expand output severalfold in the next decade or two. Even the small mines in the Province have come into prominence; during the first 9 months of 1977, combined output of Shansi's small mines reportedly totaled 24 million tons.

Shansi's two leading producers were Tatung and Yangchuan. At the Tatung combine, which has 13 collieries, production in 1976 was reported at 18 million tons of marketable coal[41] and projected production in 1977 was 21 million tons. Westerners have visited at least three of its collieries. The new Chinhuakung colliery near the city of Tatung may have a half billion tons of reserves of low-ash, low-sulfur, high-heat-value bituminous coal (including coking coal) which is produced at about 2.5 million tpy and shipped to north China markets as far as Peking. The nearby 50-year-old Meiyu underground mine also has about half billion tons of reserves and covers 15 square kilometers. With 10 gently dipping seams of 1- to 10-meter thickness, Meiyu's 1977 output was about 1.8 million tons of 10% ash (before cleaning) steam coal. The Yunkang colliery, although 35 kilometers northwest of the Meiyu mine in the same coalfield and also under the Tatung combine, produced about 2.5 million tons of steam and blending coals in 1977 with plans to more than double this within a decade. The Yunkang mine covers an area of 80 square kilometers, has 13 coal seams (2 seams now worked are 4 and 6 meters thick), and mines from shafts now about 200 meters deep. The Yangchuan combine in Shansi is China's largest anthracite producer, and output in 1977 apparently was over 13 million tons. Yangchuan collieries are highly gaseous.

Coal production in Liaoning Province remained relatively stable; the Province provided about 12% of the national output and maintained its second ranking position after Shansi. Fushun's two open pits and three underground collieries together produced 12 to 14 million tons of marketable steam and blending coals in 1977, from gently dipping and very thick coal seams overlain by oil shale. Specifically, the Fushun West open pit mine produces about 4.5 million tons of cleaned coal annually, and the Lau Hu Tai underground mine, 3.5 million tons. Liaoning's other large coal combine Fuhsin maintained output at about 18 million tpy. A few interesting statistics were mentioned for Heilungkiang's large coal combines. The Hokang combine produced a record 63,000 tons of raw coal on May 1, 1977, but the average for the year was probably less than 50,000 tpy. The Chihsi combine produced in excess of a million tons monthly in the spring of 1977, and the Shuangyashan combine increased output every month during the first half of the year. Shensi Province's Tungchuan combine reported output at 6 to 7 million tons in 1977. China's first combined coal-natural gas operation, at the Shih-Chieh mine in Shansi, came onstream.[42] In Shantung Province, Tzupo combine's output was reported at 5.8 million tons in 1976, and Tsaschuang combine reportedly established a daily output record of 31,000 tons in August 1977 (about 17,000 tpd in May 1977).[43]

The fairly new Pintingshan combine in Honan Province and its coking coal was in the news again. Production was in shambles in 1976, according to Chinese official reports, because of the "gang of four." Pingtinshan has about a dozen collieries; its Kaochuang or No. 4 mine and its No. 10 mine had been classified as "advanced large collieries," and its No. 1 mine had been rated at 1.5 million tpy. A report in late 1977 indicated that Pingtingshan's 1975 output was more than 10 million metric tons (possibly raw coal) and that output during March-September 1977 had exceeded 1 million tons for every month.[44] Thus, management difficulties had been overcome, and production brought up to record levels, so as to meet the growing needs of the steel and other industries in north-central China.

The Wuta combine (also called Holanshan) in Ninghsia was again reported in literature.[45] It is located on the railroad west of Paotou and north of Yinchuan. Holanshan embraces four coalfields in an area of 50 kilometers, and has eight pairs of shafts, an open pit mine, a large coal washing plant, and many auxiliary facilities serving steel and other industries in the northwest. Although Wuta has 20 years of

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history, the surge in output came in 1975. Production in 1976 was said to be 23% higher than in 1975, and production in the first half of 1977 went up another 16% compared with the same period in 1976. Overall output in Ninghsia Province probably was at least 8 million tons, and most of this came from the Wuta combine.

Szechuan Province in the southwest, noted for agriculture, bamboos, pandas, natural gas, and brine salt, has uncovered a large iron deposit and was building up its coal production. The Province probably produced about 15 million metric tons of bituminous coal in 1977, registering at least a 20% increase over that of 1976. The premiere combine is Paoting in rugged terrain near the Yunnan border where there are seven collieres, a cleaning plant and other industrial facilities, producing medium-volatile coking coal. There are many other smaller coal mining enterprises, including Yungjung, Fujung, Jungshan, and Chiayang. Except for Paoting, Szechuan coal mines are relatively small, although there are many seams to work.

Petroleum and Natural Gas.—China's oil production was between 90 and 100 million metric tons (or 2 million barrels per day) in 1977. The official line was that the increase was about 8% over that of 1976, compared with an increase of 13% in 1976 over that of 1975. Taching and No. 1 oilfield Shengli did very well, but the No. 4 oilfield Takang apparently faltered because of the earthquakes in the second half of 1976. Little was said about the new Panshan oilfield near Chinchow and Yingkou. However, there seemed to be great enthusiasm over a fifth large oilfield, a newly reported one south of Peking called Huapei or north China oilfield, where high-yield wells and sharp increases in output were claimed. The old northern Sinkiang field continued to make progress and a new southwestern Sinkiang field apparently has been uncovered. Nearby, there was also great activity in Tsinghai Province.

China already ranks about tenth as a world oil producer, and prospects of doubling output by the latter part of the 1980's are excellent. Further growth to beyond 200 million tpy would be rather conjectural on the basis of present knowledge. However, the reserve situation (particularly onshore but also offshore) seems good when compared with the major oil producers in the world outside of Saudi Arabia. One report indicates that Vice Premier Teng Hsiao-Ping told Japanese Parliament members in late 1977 that the new estimate of Chinese oil reserves is 400 billion barrels (7.4 barrels equal one metric ton).[46] China's oil industry was clearly moving upward, with additional reserves found in existing oilfields, reports of completely new oilfields, and indications that petroleum also occurs in older and deeper Paleozoic rocks. At Taching, very important reserves have been located at greater depths and around the fringes of the present oilfield. At Shengli, extensive reservoirs and structures have been discovered at 3,000 meters and deeper. The Huapei oilfield has just started normal operations and Supei to its southeast also shows good promise. Not too much exploration work has been done in Sinkiang and Tsinghai as yet. As noted below, offshore exploration is gaining momentum.

The Chinese have sent many oil and gas delegations abroad. Probably the most interesting and high-level one came to the United States in January 1978, headed by the president of the China Petroleum and Natural Gas Corp. An American oil drilling equipment mission was in China in the late summer of 1977, followed by a technical mission of U.S. oil executives later in November. All signs point to the fact that China has already found extensive oil reserves, expects to discover even more, hopes to sell larger quantities of petroleum abroad, wants to learn from oil producers around the world and particularly from the West, intends to buy considerable equipment and technology to explore for (especially offshore) and refine oil, and with the proceeds from oil exports, plans to purchase foreign metal supplies, machinery, plants, and know-how for industrial development in general.

While the Chinese have never shown any interest in joint ventures and appear to be only remotely inclined to accept the concept of work contracts, they apparently were ready to make a deal with the French in November 1977 that would represent a breakthrough in their commercial arrangements.[47] In negotiating to buy $250 million worth of French oil drilling technology and equipment (possibly for the development of the new Nanhai oilfield near Canton), which the West hopes would be the beginning of a new wave of Chinese buying, the Chinese may agree to accept financing by the French state-owned Banque Nationale de Paris for the purchase. Hitherto, loans have not been accepted by the Chi-

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nese, although time deposits have been previously arranged with the Japanese.

While concentrating on their own technical resources for exploration onshore (they are, however, interested in U.S. oil-prospecting data analysis computers), the Chinese were looking more into foreign equipment and know-how for offshore operations. Generally, they feel that over 40% of China's land area and half that much Continental Shelf area have potentially oil- and gas-bearing sedimentary rocks conducive to oil search. Peking indicates that it might have started offshore drilling around the Spratley Islands of the controversial South China Sea. As of yearend 1977, China was operating three foreign-built rigs offshore, had a fourth on order, and finally purchased a fifth.[48]

In the early stages of offshore operations, concrete and earthen dikes were built a mile into the Gulf of Pohai. By the late 1960's, a number of four-legged fixed platforms were installed. In 1972, a Fuji rig was put to use and in 1973, China built its catamaran drillship called "Kantan I." Subsequently, Singapore's Robin Loh built and sold two Rabray 300 jack-up rigs for the Chinese after fitting them with Houston ETA Engineering's equipment; their Hitachi partners in Japan filled a third order. These roughly $20 million rigs (with U.S. equipment on board worth another $10 to $15 million each) operate in 300 feet of water and have 25,000 feet drilling capability. One of these ran into technical trouble while working 50 miles off Pakhoi (Peihai) in the Gulf of Tonkin and foreign experts had to be flown in to make repairs. In the summer of 1977, the Norwegian-owned Borrgny-Dolphin, which had operated in the North Sea, was bought for $27 to $40 million. This latter semisubmersible rig can work at 600 feet (1,000 feet if modified) and probably will be used near Hainan Islands. In November 1977, the Texas-based National Supply Co. sold two self-contained drilling rigs to the Chinese for a total of $20 to $30 million.

The Chinese exported considerably less oil in 1976 and 1977 than they had hoped. However, exports totaled very possibly 10 to 11 million metric tons in 1977, including roughly 6.5 million tons to Japan, over a million tons to North Korea (pipeline there has capacity of 1.5 million tpy), 900,000 tons to the Philippines, 700,000 tons (products) to Hong Kong, 500,000 tons to Romania (barter agreement for Romanian fertilizers), and up to a half million tons to Thailand. Cambodia was said to have imported 600,000 tons of Chinese oil products in 1975. Singapore may be taking some Chinese oil to pay for Chinese purchases there.

The Sino-Japanese long-term agreement for Chinese oil was practically firmed up by January 1978. Japan will take 47 million tons of crude oil during 1978-82, with 6.8 million tons programed for 1978 and 15 million tons for 1982. The coal part of the deal involving about 5 million tpy exports to Japan evidently has not yet been finalized. Japan is thinking about installing its first heavy oil cracking facilities to treat heavy Chinese crude by 1981, after which time some Japanese observers believe that crude imports from China can go as high as 20 to 30 million tpy. Crude from Shengli and Huapei oilfields were being sent to Japan for testing at yearend 1977, indicating the likelihood of shipping commercial quantities of these crudes there in addition to Taching crude. North China crudes are lighter but more salty than Taching crude, and higher in sulfur. Taching crude is more waxy than Indonesia's Minas crude but has less nitrogen. Shengli crude now goes to the Philippines, where Caltex and other companies are gearing up on anticorrosion facilities. Caltex shipped 45,000 tons of Taching crude to Sydney's Kurell refinery in 1976, and has arranged to ship 100,000 tons of Taching crude to its Japanese affiliate Nippon Oil. The possibility of more Chinese crude going to Japan worries some refiners there.

The Taching oilfield, near Harbin and only 180 miles from the Soviet border, apparently produced 40 to 45 million metric tons of crude oil in 1977. Its target for that year reportedly was fulfilled by December 26, and actual output was said to have been the highest in history, possibly even more than the 45 million tons mentioned above. There were indications that Taching was holding down output by shutting off wells, because of the weak domestic and international demand for its oil. There were two major announcements concerning exploration—at greater depths and around the perimeters of the oilfield known to cover at least 150,000 square kilometers. The management of Taching was extremely confident that oil reservoirs (at 3,000- to 4,000-meter depth) under the presently known ones (average depth about 1,000 meters) have as much reserves as the shallow reservoirs.[49] Four exploratory holes

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have been drilled to about 3,000 meters, with the expectation of locating commercial structures by the spring of 1978. A simultaneous thrust was to develop oil in a new region in the southern part of the oilfield.

Thus Taching, possibly one of the world's 10 leading oilfields, holds good promise for the future and probably has not peaked at all. Operators at this field indicate that reservoir pressures have been generally steady, most wells still maintain their natural flows, production remains at high levels, and new techniques of fracturing and water injection have been successfully applied. Taching's refinery remains at about 6 million tpy, but the petrochemical complex has been made more sophisticated. There are now two large foreign designed chemical fertilizer plants (American and Dutch), one or both rated at about a million tons of finished fertilizers per year.

The Shengli oilfield, located at the mouth of the Yellow River and covering 80 (east-west) by 120 kilometers (north-south), is hopefully being built up to another Taching. It has about 100,000 workers, roughly the same as Taching. Output in 1976 for Shengli was close to 18 million metric tons, and the tonnage in 1977 was probably higher. A number of high-yield oil wells were drilled (to about 3,000 meters) and placed in operation during 1977, to supplement the existing producing wells mostly 1,000 to 2,500 meters deep.[50] Geological exploration verified that similar deep and faulted formations exist widely in the area. Drilling and construction were proceeding rapidly in the new oil area, and additional roads and pipelines (two important ones at present are to Tsingtao and Tzupo) were being built. Management at Shengli claimed very efficient drilling with artificial diamond drag bits (in place of alloy drag bits) for deep holes and a high-pressure jet-drilling technique. Reportedly, new "chain" pumps were also effective. There has been no additional news on the scheme to alter the course of the Yellow River, designed to facilitate oil extraction.

Shengli is rather integrated, possessing additional facilities like two fertilizer plants, two refineries totaling 6 million tons in annual capacity, a synthetic rubber plant, and a petroleum institute. Overall, Shengli's capacity will be increased considerably in the next few years; its current output is less than half that of Taching's. Additional markets were being sought for Shengli's heavy and salty oil.

The Kwangchow petrochemical works near Hong Kong received its first shipment of Shengli crude in August 1977. About 900,000 tons of this crude also went to the Philippines in 1977, with the expectation that much larger tonnages will be shipped there; Caltex, the leading importer in that country, was planning to install more anti-corrosion equipment in its refinery to cope with Shengli oil. Samples of Shengli oil were being sent to Japan, in anticipation of sizable exports there.

There has been very little news about the Takang oilfield near Tientsin and earthquake-ridden Tangshan, often mentioned as China's No. 3 oilfield. Takang reportedly resumed normal operations shortly after the Tangshan earthquake in late July 1976. However, things may not have been running too smoothly and certainly Takang's expansion plans might well have been delayed. Also, Tientsin and Peking, which have been markets for Takang's oil and gas, went through additional earthquakes late in 1976 and these quakes apparently did slow down Takang. Thus, it would not be surprising if Takang's 1977 production dropped below 10 million tons. Another new large oilfield in Pohai Bay and northeast of Takang, which can be designated as Yingkow-Chinchou or Panshan, also has not been mentioned much in the press during 1977. The Panshan field, which is on land but very possibly extends into the bay, was not affected by earthquakes at all. It was apparently still being developed, although output no doubt has already surpassed the 5-million-tpy level.

Another large new oilfield came to light in 1977, which can be designated as Huapei or Jenchiu. It covers a large area that has not yet been carefully delineated. Centered in Jenchiu county southeast of Paoting in Hopeh Province, it is known to cover four counties extending from almost Peking south to the Shanghai railroad. Various thousand-ton-per-day wells have already been developed in the Kuchien Mountain area.[51] In developing this field, Paleozoic rock was found in an oil-bearing structure, which was named Kuchienshan formation. To Chinese oil geologists, this means that exploration should not cease upon passing through younger formations and that Huapei (means North China) and other areas in the country could have much additional oil potential, in view of the widespread nature of Paleozoic rocks. Oil production in this field no doubt has been increasing sharply

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and samples have been shipped to Japan in the hope of future sales there. The Chinese also feel most hopeful that another large field will be developed farther south and east in southern Shantung and northern Kiangsu; this field has been designated as Supei (meaning Kiangsu North).

The Karamai or Kolamai oilfield located in western Dzungarian Basin in Sinkiang Province was again cited for good performance in 1977 which implies that overall output may have surpassed 7 million tons. This oilfield was being streamlined in recent years, along with the development of a new sub-field and construction of more refining facilities. Much exploration has also taken place in the Tarim Basin (Takla Makan) in southwestern Sinkiang and apparently good reserves have been found. China's oldest oilfield, Yumen in Kansu Province, probably produced 3 to 4 million tons of crude oil in 1977, after its seventh year of "rejuvenated" good performance based upon discovery of additional reserves at deeper reservoirs. Yumen has a local refinery and sends oil by pipeline to the Lanchow refinery as well.

Development of the Tsaidam Basin in Tsinghai Province has moved ahead, although production particulars are not known.[52] "Derricks in Tsaidam are lined up like forests," and about two hundred highways have been built in "this land of minority people." By September Tsinghai's 1977 drilling plan reportedly had been 89% fulfilled, and the crude oil output target, 87% fulfilled. Several oilfields have been reported for western Kirin Province in northeast China, that is, Chiling, Hungkang, and Hsimu); developed in the last decade, at least one of these fields is said to be relatively large and stable in yield. Little is known about the exploration offshore in the Nanhai area south of Canton.

China's natural gas production is moving up sharply, registering about a 22% increase over that of 1976 compared with a growth of 11% a year earlier. Output in 1977 may have reached 95 billion cubic meters, one-sixth of U.S. production and a fourth of U.S.S.R. production. Szechuan Province has long been famous for natural gas itself, although increasing quantities of oil are produced also. At yearend 1977, China contracted to buy a $20 million natural gas clearing plant (to remove oil, sulfur, and water) from Chiyoda Kako of Japan, presumably for use in Szechuan. Production of gas in Szechuan has gone up fivefold since the Cultural Revolution.[53] Several hundred gas-oil structures have been found in the last few years. Methods have been devised to produce gas from high-pressure wells and work sour gas. Strong artificial diamond drill bits and special tungsten carbide bits have been made and used in drilling holes that are mostly more than 4,000 meters deep. Szechuan's and China's deepest well was 7,058 meters, as of July 1977.

In Szechuan, gas is used to run most of the fertilizer plants, powerplants, steel plants, salt facilities, and many cement plants as well. This gas is also being sent to southeast China via pipeline which apparently has already reached Changsha. Szechuan has about a hundred small and several large fertilizer plants that use gas. Natural gas is also associated with most of the leading oilfields. Eventually, the Chinese hope to sell liquefied natural gas (LNG) from Takang to Japan. Takang's gas already goes to Tientsin and Peking.

China's largest shale oil operation is now Maoming (Mowming) located in Kwangtung Province. Its overall prominence, however, is due mainly to the recent installation of a regular oil refinery and a 140-kilometer pipeline from Chanchiang to bring outside crude in, including Iranian crude oil. Maoming's shale oil operation produces by-products like cement and rare minerals and metals. It is known that there are also six shale oil retorting plants which together may be producing 1 to 1.5 million tpy of shale oil. One report states that Maoming's shale oil production and crude oil production both increased about threefold during the decade ending 1975. It has a new lubricants plant and five new "installations for removing and producing sulfur."[54] Reportedly, Maoming fulfilled 1977 industrial production targets 1 month ahead of time, and its gross industrial output was 14% higher than a year before. Output of refined oil products at Maoming was roughly 11% higher than in 1976. China's second and oldest shale oil operation Fushun in Liaoning Province continued to diminish in importance because of natural oil coming from Taching and less local oil shales mined at the open pit coal mines. There seem to be nine batteries of oil shale retorts that together could produce 1 to 1.5 million tons of shale oil yearly. Probably less than half of the facilities are now worked, and the 1977 output might have been as low as 600,000 to 800,000 tons of retorted oil. China's effort to

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build pipelines, ports, and vessels to ship oil and gas (and eventually perhaps also coal dispersed in oil) continued to make steady progress. Apparently, there are just over 5,000 kilometers of trunk pipelines in the country at present (excluding local gas pipelines in Szechuan totaling well over 1,000 kilometers). One of the longest pipelines is from the Taching oilfield via Tiehling and Chinhuangtao to Peking. Taching oil is also piped to Talien and North Korea. Another long pipeline is from Szechuan to the east coast around the oil and gas fields. Purchase and manufacture of pipe obviously have high priority.

When the oil reaches ports, China has the problem of moving it to domestic and foreign markets. In recent years up to 50 deepwater berths have been built from north to south in Talien, Chinhuangtao, Tientsin, Yentai, Tsingtao, Lienyunkang, Shanghai, Whampoa, and Chanchiang. Talien's Hsinkang Harbor can accommodate a 100,000-dwt (deadweight ton) tanker and 50,000-dwt tanker simultaneously. Another new completion was the Huangtao port in Tsingtao Harbor which can now handle a 50,000-dwt tanker and a 20,000-dwt tanker simultaneously. Changchiang can also berth 50,000-dwt ships. However, most berths in China can only handle 10,000-dwt to 30,000-dwt tankers, although many can load and unload coal also. The country's tanker fleet has been built up to about a million tons, two-thirds comprising of about 20 vessels purchased from Scandinavia, the largest of which is the 89,200-dwt Josephine. The maximum-size Chinese-built tanker is 50,000-dwt, and the first of four is called Hsihu. China's present fleet can only handle about 3 to 4 million tons of annual oil exports. Apparently, Chinese thinking is to handle half of future oil exports with tankers built domestically and purchased.

China's oil refining and petrochemical facilities were being expanded at a pace commensurate with the increase in crude production. Judging from exports and the extent of direct burning of crude, it appears that the country's refining capacity has reached about 80 million metric tons per year. Chinese refineries are basically of two types—an "Esso" type of about 2.5 million tpy and a Soviet type of 1.8 to 2 million tpy; at one location, one or more basic units can be constructed. The Chinese have become very good at building more of the same, but with minor variations.

Among the new large refining and petrochemical complexes being built or just completed are Whampoa (Kwangchow or Kwangtung) near Canton, Chinshan near Shanghai, Takang (delay likely), Chekiang possibly near Hanchow, Chiuchiang in Kiangsi Province, and Urumchi in Sinkiang. Other older large refineries are located at Fushun, Taching, Lanchow, Shanghai (old one), Peking, Shengli, Talien (or Dairen), Chinhsi, Nanking, Anshan, Maoming, Yumen, Tientsin, and Karamai-Tushantzu. Much has been reported about the 7-million-tpy Peking and petrochemical complex. It fulfilled quotas by December 20, 1977, with a reported 46.7% increase in output value over that of 1976.[55] The German firms Lurgi and Zimmer and Standard Oil of Indiana will furnish important additions to Peking's petrochemical facilities. China also has small refinery-petrochemical works, such as a 50,000-tpy plant at Changchow, Kiangsu Province, which produces refined oil products, fertilizers, insecticides, chemicals and acids, plastics, resins, and medicines, etc.[56]

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The Mineral Industry of Colombia

By Orlando Martino[1]

In 1977, Colombia's economic recovery continued to be slow and hesitant following the recession of 1975. The gross domestic product (GDP), estimated at $16.6 billion[2] at current prices, grew 4.5% in real terms, considerably below the pre-1974 rate of 7%. The rate of inflation was almost 30%, compared with the 26% rate of 1976.

The mineral industry of Colombia continued to be dominated by the production of crude petroleum, natural gas, and coal. Except for gold and platinum, production of metallic minerals was limited and represented only a small share of the GDP. Colombia remained a significant world producer of platinum in 1977, ranking fourth after the U.S.S.R., the Republic of South Africa, and Canada. The volume of production of minerals and mineral fuels was generally below the level of 1976. The mining sector, excluding mineral fuels, accounted for less than 1% of the GDP, 7% of exports, and 1% of employment.

During 1977, Colombia took further steps to exploit its mineral potential. Production by the extractive industries has been modest because they have been handicapped by the large investments required, the shortage of technical personnel, and a lack of transportation facilities. The Government was attaching increased importance to developing the mineral sector in order to take advantage of a significant source of employment, economic growth, and diversification away from coffee exports. The Government sought to rejuvenate its mining tradition and was encouraging development of mineral reserves with a new policy of using joint venture agreements between Government agencies and local and foreign private investors. Mining investment was also being encouraged by sales tax exemptions for imports by mining companies and special tax incentives established by the Tax Reform of 1974.

While Colombia has not actively sought foreign investment in most sectors of the economy, a favorable climate exists for potential investors in export-oriented industries located outside the major cities. On the basis of project plans and arrangements with foreign investors for financial and technical assistance, Colombia was expected to become a significant producer and exporter of copper, nickel, phosphate rock, steam coal, and liquefied natural gas (LNG). Development of coal and natural gas deposits was of particular interest as a means of providing alternative energy sources and improving Colombia's balance of payments situation. Among the Government-sponsored mining projects, further exploration and development of the Cerrejón coalfield is likely to be Colombia's most important project over the next 10 years. To reverse the declining trend in crude oil production and regain Colombia's self-sufficiency, the State-owned petroleum company Empresa Colombiana de Petróleos (ECOPETROL) was developing an exploration program to invest $116 million during the 1978-80 period. However, in the short term, except for coal and gas, overall mineral production was not expected to increase notably above historical levels.

The Instituto Nacional de Investigaciones Geólogo-Mineras (INGEOMINAS), a dependency of the Ministry of Mines and Energy, continued to expand mineral exploration supported by technical assistance from the United Nations Development Program (UNDP). By early 1977, INGEOMINAS had geologically mapped about 10% of the national territory, and more detailed exploration was accomplished in no more than 25% of the mineralized areas.

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PRODUCTION

Despite the wide diversity of mineral occurrences in Colombia, mining and processing of metallic and nonmetallic minerals remained limited to a few commodities. In 1977, production of pig iron decreased 22%, and that of crude steel decreased 8%. Colombia's production of steel was among the lowest in Latin America, at 13 kilograms per person, compared with 100 kilograms per person in Argentina and Brazil.

While output of platinum rebounded, gold and silver production decreased. Output of manganese remained unchanged, and that of mined chromite dropped sharply. Among nonmetals, cement production decreased 9% after the peak output of 1976. Mining of emerald resumed in 1977 following a period of suspended operations. Output of rock salt declined slightly, but that of marine salt dropped 20%.

Among the mineral fuels, coal production increased slightly and that of natural gas increased to a record high. In contrast to a further decline in crude oil production of 6%, refinery output increased slightly.

Table 1.—Colombia: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]		1975	1976	1977[p]
METALS				
Chromite, gross weight		r e3,500	r e5,000	3,000
Copper, mine output, metal content		--	--	900
Gold	troy ounces	311,321	300,307	263,437
Iron and steel:				
Ore and concentrate	thousand tons	r537	498	460
Metal:				
Pig iron	do	r293	286	223
Ferroalloys (ferrosilicon only)[e]		1,000	r1,200	1,200
Crude steel	thousand tons	391	356	327
Semimanufactures, hot-rolled	do	301	300	294
Lead, mine output, metal content		114	126	126
Manganese ore, gross weight		14,000	r e6,000	e6,000
Platinum-group metals	troy ounces	22,114	16,779	17,300
Silver	do	r87,562	106,812	91,420
Zinc, mine output, metal content		7	60	--
NONMETALS				
Asbestos		--	e5,000	--
Barite		3,000	3,500	e3,450
Cement, hydraulic	thousand tons	3,091	3,612	3,298
Clays:				
Bentonite		1,000	1,200	--
Kaolin[e]		105,000	110,000	e954,200
Other[e]		750,000	NA	--
Diatomite		600	600	e690
Feldspar		r30,000	35,000	26,508
Fertilizer materials, crude: Phosphate rock		13,000	13,500	8,100
Gypsum	thousand tons	r200	205	210
Lime	do	7,800	8,000	e8,000
Magnesite		785	1,732	1,770
Precious and semiprecious stones: Emerald:				
Gem stones	carats	NA	NA	60,575
Morralla	do	NA	NA	r423,937
Total[3]	do	248,714	499,802	484,512
Salt:				
Rock	thousand tons	r184	186	181
Other	do	741	925	741
Total	do	r925	1,111	922
Sodium and potassium compounds: Caustic soda		58,294	55,817	36,195
Stone and sand:				
Calcite		7,200	7,800	8,280
Dolomite	thousand tons	30	23	22
Limestone	do	7,800	7,800	8,112
Marble	cubic meters	3,500	35,500	38,292
Sand, not metal bearing		370,000	860,000	840,000
Sulfur:				
From ore		r23,622	21,880	18,000
Petroleum refinery byproduct		2,000	2,000	e2,000
Talc, soapstone, pyrophyllite		r1,620	1,000	e1,150

See footnotes at end of table.

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Table 1.—Colombia: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]		1975	1976	1977[p]
MINERALS FUELS AND RELATED MATERIALS				
Asphalt, natural	thousand 42-gallon barrels	554	566	458
Carbon black		e21,800	e26,300	4,200
Coal, all grades	thousand tons	3,800	4,000	4,204
Coke, all types	do	420	400	500
Gas, natural:				
Gross	million cubic feet	r120,754	117,924	122,325
Marketed	do	65,905	66,715	74,217
Natural gas liquids:				
Propane	thousand 42-gallon barrels	2,811	3,041	e2,645
Butane	do	734	666	582
Natural gasoline	do	1,324	1,094	700
Condensate	do	442	398	373
Total	do	5,311	5,199	4,300
Petroleum:				
Crude	do	57,259	53,376	50,222
Refinery products:				
Gasoline:				
Aviation	do	428	360	373
Motor	do	21,318	21,037	21,727
Kerosine	do	3,355	3,291	3,156
Jet fuel	do	2,445	2,732	2,895
Distillate fuel oil	do	6,619	7,488	7,505
Residual fuel oil	do	17,496	18,001	18,420
Lubricants	do	311	339	35
Other:				
Liquefied petroleum gas	do	1,753	2,100	2,043
Naphtha	do	NA	NA	1,189
Asphalt and bitumen	do	554	565	458
Unspecified	do	2,393	59	--
Refinery fuel and losses	do	1,013	3,112	2,563
Total	do	57,685	59,084	60,364

eEstimate. pPreliminary. rRevised. NA Not available.

[1]In addition to the commodities listed, manufactured fertilizer materials and coal briquets are also produced, but output is not reported quantitatively and available information is inadequate to make reliable estimates of output levels.

[2]Figure represents emerald imported by the United States, consisting primarily of morralla and gangue but also including some emerald of gem quality.

[3]Exports.

TRADE

Over the past 5 years, Colombia has had steady expansion in its international trade. In 1977, total exports, valued at $2.3 billion, increased 30%, and imports, totaling $2.7 billion, increased 34%. However, the role of minerals is minor, contributing less than 7% of total exports in 1977.

The drop in production of crude petroleum, coupled with the growth in domestic demand, made it impossible for Colombia to resume exports of crude oil discontinued after 1974. However, Colombia continued to export residual fuel oil, mostly to the United States, from ECOPETROL's refinery in Cartagena. Of the total of 484,500 carats of emerald exported in 1977, 87% went to the United States. Shipments overseas of portland cement, in a sharp upward trend in the 1972-76 period, declined 36% in 1977 to 433,000 tons. Exports of ammonia have been declining owing to increased domestic demand for fertilizers. It was expected that Colombia would resume sizable exports of fertilizers in 1980 when the expansions of several fertilizer plants are completed. On the basis of projects being planned, Colombia was also expected to become a significant exporter of nickel, steam coal, and LNG in the 1980's. Exports of coal were projected to earn $18 million in 1980, $190 million in 1985, and $650 million in 1990. The value of major mineral-related exports in terms of payments received is as follows, in million dollars:

Commodity	1976	1977	Percent change
Fuel oil	83.9	104.6	+25
Emerald	13.2	24.2	+83
Cement	24.5	16.5	-33
Platinum	1.7	.9	-47
Other	5.2	10.6	+104
Total	128.5	156.8	+22

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Imports of crude oil, received at the rate of 25,750 barrels per day mostly from Venezuela, were valued at $131 million. These imports, together with imports of refinery products, mostly from Brazil and Aruba, required $187 million in foreign exchange in 1977. Imports of iron and steel amounted to $133 million. Colombia continued to rely heavily on imports to satisfy its demand for nonferrous metals, especially aluminum, copper, lead, and zinc. In 1977, imports of earth-moving and mining equipment amounted to $30.5 million, 62% of which were from the United States. Although overall imports from the United States increased 21% in 1977, their share in the Colombian market dropped from 38% to 34%, largely because of the rapid growth of petroleum imports.

Table 2.—Colombia: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1976
METALS	
Aluminum metal including alloys, all forms	364
Chromium ore and concentrate	3,807
Copper:	
Ore and concentrate	1,780
Metal including alloys, unwrought and semimanufactures	9
Gold:	
Ore and concentrate	418
Metal, unworked or partly worked, troy ounces	6,559
Iron and steel metal:	
Pig iron, ferroalloys, similar materials	8,802
Steel, primary forms	55
Semimanufactures:	
Bars, rods, angles, shapes, sections	1,280
Universals, plates, sheets	510
Hoop and strip	6
Rails and accessories	1,300
Wire	513
Tubes, pipes, fittings	1,735
Castings and forgings, rough	148
Total	5,492
Lead:	
Ore and concentrate	234
Metal including alloys, all forms	9
Nickel metal including alloys, all forms	1
Platinum-group metals and silver:	
Ores and concentrates, thousand troy ounces	13,433
Metals including alloys, do.	14
Zinc metal including alloys, all forms, kilograms	330
Other:	
Ash and residue containing nonferrous metals	116
Base metals including alloys	1
NONMETALS	
Abrasives, natural (including industrial diamond), kilograms	287
Cement	677,370
Fertilizer materials:	
Manufactured	27,914
Ammonia	5,421
Precious and semiprecious stones, kilograms	3
Sodium and potassium compounds: Caustic soda	4,615
Stone, sand and gravel	247
Other, crude	1,557
MINERAL FUELS AND RELATED MATERIALS	
Carbon black	10,160
Coal:	
Anthracite	15,666
Bituminous	3,085
Coke and semicoke	33,896
Petroleum refinery products: Residual fuel oil, thousand 42-gallon barrels	8,767

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Table 3.—Colombia: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1976
METALS		
Aluminum metal including alloys, all forms		16,032
Copper metal including alloys, all forms		5,863
Iron and steel:		
Ore and concentrate		397
Metal:		
Scrap		8,815
Pig iron, ferroalloys, similar materials		8,043
Steel, primary forms		13,153
Semimanufactures:		
Bars, rods, angles, shapes, sections		21,731
Universals, plates, sheets		162,096
Hoop and strip		4,517
Rails and accessories		625
Wire		4,064
Tubes, pipes, fittings		53,511
Castings and forgings, rough		67
Total		246,611
Lead:		
Oxide		1,029
Metal including alloys, all forms		2,958
Manganese:		
Ore and concentrate		4,446
Oxide		744
Nickel metal including alloys, all forms		228
Platinum-group metals and silver:		
Ores and concentrates	troy ounces	579
Metals including alloys	do.	27,264
Tin metal including alloys, all forms		324
Titanium oxide		473
Zinc metal including alloys, all forms		11,981
Other:		
Ores and concentrates		3,002
Ash and residue containing nonferrous metals		663
Metals including alloys, all forms		94
NONMETALS		
Abrasives, natural (including industrial diamond)		860
Asbestos		19,954
Clays and clay products (including all refractory brick):		
Crude: Kaolin		3,208
Products, refractory (including nonclay brick)		6,419
Fertilizer materials:		
Manufactured:		
Nitrogenous		23,093
Potassic		16,700
Ammonia		23,035
Pigments, mineral: Iron oxides, processed		727
Sodium and potassium compounds		1,640
Stone, sand and gravel:		
Dolomite, chiefly refractory grade		4,917
Other		21,347
Sulfur, elemental, other than colloidal		24,750
MINERAL FUELS AND RELATED MATERIALS		
Carbon black		681
Coal, coke, peat		65
Gas, hydrocarbon, natural and manufactured	kilograms	7,112
Petroleum:		
Crude	thousand 42-gallon barrels	6,725
Refinery products:		
Gasoline:		
Aviation	do.	35
Motor	do.	2,617
Distillate fuel oil	do.	40
Lubricants	do.	20
Other	do.	11
Total	do.	2,723

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COMMODITY REVIEW

METALS

Aluminum.—Colombia continued to rely primarily on imports of ingots, mostly from Venezuela, to meet its growing demand for aluminum. In 1977, ingot imports amounted to 13,000 tons valued at $15 million. Imported bauxite was apparently utilized in nonmetallic industry applications, whereas the ingot and semimanufactures were processed by several rolling and extrusion mills.

Chromium.—Production of chromite has increased greatly since 1959 when an output of 40 tons of ore was first reported, although 1977 registered a sharp decline. Cromitas Ltda., a subsidiary of Coltejer S.A., one of the largest textile producers in Colombia, continued to be the only producer, near Medellín. Feasibility studies were being conducted to expand production. Most of the chromite was exported to the United States.

Copper.—Colombia continued to rely on imports of primary copper to meet domestic demand. Copper imports have increased steadily in line with Colombia's increased industrialization and growth in population.

INGEOMINAS, with assistance from the UNDP, completed prefeasibility studies of the porphyry copper deposits of Pegadorcito-Pantanos and Murindó, discovered in the adjoining Departments of Antioquia and Chocó. Empresa Colombiana de Minas (ECOMINAS), a State-controlled agency, was designated to develop these deposits. Financial assistance of $3.4 million was being sought from the World Bank's Consultative Group for Colombia and from the Canadian International Development Agency (CIDA).

INGEOMINAS has been involved in studies since 1970 to determine the amount and quality of other copper deposits at Rovira (Tolima), El Pismo and Silva (Cauca), Mocoa (Putumayo), and Patasery and El Encanto (Nariño). To date, 500 million tons of potential copper ore has been identified.

Gold, Platinum, Silver.—Colombia was the second leading gold producer in Latin America in 1977 and ranked 12th worldwide. In the period 1972-75, gold output increased at an average annual rate of 21.5%. Following the small decline of 3.5% in 1976, output decreased 12% further in 1977. A 20% increase is expected in 1978.

During 1977, foreign companies exploiting gold, platinum, and silver in Colombia were purchased by a newly formed Colombian private corporation, Mineros Colombianos S.A. This corporation, which owns and operates over 60 mines, operated six dredges in the Departments of Antioquia and Chocó and was planning to purchase another dredge for use in 1978. Platinum was produced as a byproduct of gold from deposits primarily in Chocó. Output of platinum, which had been declining since 1973, rebounded in 1977. Output of silver, which had been increasing at an average annual rate of 13% since 1972, decreased 14% in 1977. The Department of Antioquia was the major silver producer.

The Government established an 8% export subsidy and raised the internal price of gold in order to increase production, especially by the small and medium miners.

Iron Ore.—Output of iron ore came from Colombia's largest mine, located near Paz del Río northeast of Tunja in the Department of Boyacá, where the country's major iron and steel producer, Acerías Paz del Río S.A. (PDR), is located. In 1977, PDR produced 459,000 tons of iron ore, a decrease of 8%. The company's captive mines near Tunja are exploited chiefly by adit. Smaller output has come from mines at Pacho and Tibirita in Cundinamarca. In 1977, Colombia consumed 541,000 tons of iron ore in its steel operations, 56% of which was sinter ore.

PDR has estimated its iron ore reserves at 226 million tons, adequate to meet steel production needs for 35 years. Only 5 million tons at Paz del Río are open pit reserves. In addition, iron ore deposits have been found in eight other areas estimated to contain 124 million tons, of which 75 million tons is considered minable. Colombian iron ore is relatively low quality, with a 43% to 45% iron content and 11% silica content, making continued imports of higher quality ore necessary.

Iron and Steel.—Colombia's crude steel production supplied only 41% of domestic demand, which was estimated at about 800,000 tons per year of flat and formed products. The annual growth rate of consumption was 6.4% for the period 1953-75 but is projected at 8.2% through 1990. At the end of 1977, total installed capacity of 550,000 tons per year comprised one integrated steel mill (operated by PDR), six semi-integrated plants, and a pig iron producer (operated by Colombiana de Arrabio S.A.).

On the basis of project feasibility studies reviewed by Dastur Engineering International of India, PDR, the largest steel pro-

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ducer since 1950, was planning to expand its annual steel capacity in three stages: From 300,000 tons to 400,000 tons by 1979, then to 600,000 tons, and to 1 million tons by 1985. The project plans included purchase of a large arc furnace and a cold-rolled laminated steel facility. PDR has its own reserves of iron ore, coking coal, and limestone.

Dastur submitted a sector plan, financed by the United Nations Industrial Development Organization (UNIDO), for expansion of Colombia's iron and steel sector to meet future demand. The plan includes establishment of a new integrated steel plant on the Atlantic coast near Barranquilla with a capacity of 1.3 million tons per year and two direct-reduction plants to produce 220,000 tons and 350,000 tons of sponge iron per year. The direct-reduction plants would utilize the new natural gas reserves discovered on the northern coast of Colombia and would probably rely on imported iron ore of higher quality. Dastur won the bid to prepare the feasibility studies for the two plants with local financing from the Fondo Nacional de Desarrollo (FONADE).

Although Colombia produces some ferromanganese and other ferroalloys, it depends mostly on imports to meet its needs. Consumption of ferroalloys in 1977 was 8,713 tons, a sharp increase of 66% over that of 1976.

Manganese.—Production of manganese ore and concentrate has increased greatly since 1970 when output of 50 tons was first reported. Output in 1977 again fell far short of the record high level of 14,000 tons achieved in 1975. Although mining licenses have been issued covering deposits in Antioquia, Caldas, and Valle, only Antioquia had active mines, at Edabeiba and Santa Bárbara. No official estimates of manganese reserves were available.

Nickel.—Although the Government had signed a mining concession contract in July 1970 to develop the Cerro Matoso nickel deposit, work had not been initiated by the end of 1977 owing to the lack of external financing and assured markets and depressed nickel prices.

Empresa Colombiana de Niquel (ECONIQUEL) and Cía. de Niquel Colombiano S.A. (CONICOL), comprising Hanna Mining Co. of Cleveland and Standard Oil Co. of California, were involved in a joint venture to exploit the Cerro Matoso lateritic deposit located in the Montelíbano District of the Department of Córdoba. Bechtel Corp. (United States) completed a feasibility study of the $300 million mine and smelter project that was originally estimated to cost $100 million in 1970. Although long-term sales contracts had not been signed and World Bank and supplier financing of $85 million was not assured, the Government and Hanna Mining agreed in September to proceed with the Cerro Matoso project. ECONIQUEL and CONICOL were in the process of contracting Bechtel to supply and install the plant, and construction was expected to start by the end of 1978.

The plant would have a capacity for processing 850,000 tons per year of ore to produce 19,090 tons (nickel content) of ferronickel to cover domestic consumption and export. Exports were projected at $90 million per year. At yearend, Hanna Mining was negotiating with Japanese interests to purchase 15% of the output.

The estimate of proved reserves of nickel ore was revised upward to 42 million dry tons with an average nickel content of 2.5%.

NONMETALS

Asbestos.—Minera Las Brisas S.A., a private company with 27% foreign capital, continued to develop and implement a $23 million asbestos project located 160 kilometers north of Medellín (Antioquia) and 16 kilometers from Campamento. Eternit Colombiana S.A., the principal Colombian producer of asbestos-cement products, also participated in the equity of Minera Las Brisas. Initial production of 9,000 tons of asbestos fiber per year was scheduled for 1979, with expansion to 18,000 tons per year planned for 1980. Until then, Colombia will continue to depend entirely on imports to meet its asbestos fiber needs. Domestic demand was 17,000 tons in 1975.

Studies completed by Nicolet Industries Inc. of Ambler, Pa., showed that proved reserves of the asbestos deposits in the Las Brisas area are 6.4 million tons, including 2.0 million tons of marginal reserves, capable of producing 390,000 tons of asbestos fiber. The Las Brisas deposit was first explored in the 1950's and was further drilled by Nicolet in 1964 under a concession.

Cement.—The first cement plant was established in Colombia in 1905, and with the startup of the newest plant at the end of 1977, total installed capacity increased to 5.1 million tons. A total of 15 cement companies operated 42 furnaces. Since the early 1950's, internal demand has been met entirely by domestic production, and exports have grown sharply. Table 4 shows cement production and exports since 1973 and projections for 1978. Colombia has the fifth largest cement capacity in Latin America.

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Table 4.—Colombia: Production and exports of portland cement[1]

(Thousand metric tons)

Year	Production	Percent change from previous year	Exports	Percent change from previous year
1973	3,287	+8	354	+20
1974	3,484	+6	410	+16
1975	3,091	-11	408	(2)
1976	3,612	+17	718	+76
1977	3,298	-9	433	-40
1978[3]	4,000	+21	600	+39

[1]Data may differ from those reported elsewhere in this chapter owing to a difference in source.
[2]Less than 0.5% decrease.
[3]Projected figures.

Source: Instituto Colombiano de Productores de Cemento (Bogotá). 1977.

Cía. Colombiana de Clinker opened a new cement plant at Cartagena on the Atlantic coast in December 1977, the first company to open a new cement plant since 1969. The initial capacity of 600,000 tons per year was expected to be expanded to 1 million tons, with most of the output for export. Cementos Samper S.A. at Bogotá and Cementos El Cairo S.A. at Medellín were planning to construct new plants with capacities of 18,000 tons and 36,000 tons per year, respectively, for operation in 1979. At yearend, the National Planning Department rejected (based on a feasibility study) a proposal to install a 640,000-ton-per-year plant at Belencito (Boyacá).

Since oil and natural gas prices have risen sharply, several cement companies were planning to convert from fuel oil to coal, especially those companies located near abundant coal sources.

Fertilizer Materials.—*Phosphate.*—Colombia imports some 90% of the phosphates used in its fertilizer industry, which is located in the port cities of Barranquilla and Cartagena, far distant from the nation's main agricultural regions. Colombia has 15 known phosphate deposits containing 625 million tons of ore with an average P_2O_5 content of 20%. The two largest deposits alone, in the localities of Pesca and Sogamoso (Boyacá), contain a total of 495 million tons. The richest deposit, with a 28% P_2O_5 content, is at Sardinata, but only 9 million tons of ore is available.

Prefeasibility and beneficiation studies were done by the Japan Consulting Institute and the International Development Center of Alabama for the installation of a 2,700-ton-per-day phosphate mining and treatment plant at Pesca (Boyacá) and an 800-ton-per-day mining project at Sardinata (Norte de Santander). In early 1978, ECOMINAS was expected to contract for a feasibility study for a $70 million phosphate mining and fertilizer program. During 1977, the Inter-American Development Bank approved a $1.7 million loan to help finance this study. ECOMINAS and the Instituto de Fomento Industrial (IFI) will be responsible for this development program during 1978-80.

Gem Stones.—*Emerald.*—Colombia has been famous for its emerald since 1567 when the first mining company was organized to exploit emerald in the Muzo and Coscuez region of Boyacá. Since July 1974, when the mines were closed by the Government because of unrest and violence, the areas have been under the control of the national police. During 1977, the Government, through ECOMINAS, signed lease contracts with several private companies to resume mining operations at Muzo, Coscuez, and Peñas Blancas. Contracts were for 5 years, extendible to 10 years.

During the last part of 1977, the private companies made new investments in equipment, roads, and other infrastructure. Considerable investment was required to improve methods of extraction and mining efficiency. Total emerald production has been difficult to estimate because of contraband shipments; official data cover legal exports.

Limestone.—PDR exploited its own limestone deposits. The steel company's estimated total reserves were about 116 million tons, of which the 11 million tons classified as measured reserves will be adequate to meet expanded steel needs for only 7 to 10 years. Most of the companies in the cement industry have Government licenses to exploit limestone resources.

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Table 5.—Colombia: Coal consumption in 1977, by industrial sector

Sector	Consumption (thousand metric tons)	Percent of total
Iron and steel	1,222	29
Power	625	15
Cement	496	12
Paper pulp	420	10
Brick	412	10
Textiles	380	9
Caustic soda	145	4
Glass	75	2
Other, including exports	383	9
Total	4,158	100

Source: Urrutia, M. Bases para un Plan Energético Nacional. Ministry of Mines and Energy (Bogotá). 1977, p. 222.

MINERAL FUELS

The following tabulation gives the sources of Colombia's energy consumption as a percent of the total, with projections for 1985:

	1965	1975	1985
Coal	22	18	14
Natural gas	11	13	14
Petroleum	53	52	50
Hydroelectric energy	14	17	22

Source: Latin America Economic Report. Aug. 5, 1977.

Colombia's total installed electrical generating capacity is covered 30% by thermal plants using diesel oil, fuel oil, gas, or coal. As of December 1976, steam plants using coal represented only 9.4% of electrical generating capacity. By July 1977, Colombia had 22 hydroelectric plants in operation, with a generating capacity of 2,584 megawatts, and 9 plants under construction, to bring total capacity to 3,337 megawatts. Colombia's total hydroelectric potential, located in 351 sources, was estimated at 118,000 megawatts.

Coal.—Although Colombia has the largest known coal reserves in Latin America, the level and annual growth rate of coal production have been low. An extensive survey of coal-producing areas of Colombia conducted by the Ministry of Mines and Energy in 1975 revealed that 626 coal mines were active in 9 departments, employing 8,700 workers. The largest production was from Boyacá, followed by the Departments of Cundinamarca and Antioquia. There were only three large mines with production of over 120,000 tons per year, and they accounted for 41% of the country's total output. The largest coal mine, producing 600,000 tons per year, was La Chapa at Belencito (Boyacá), owned by PDR. The steel company's coking coal reserves were estimated at 198 million tons, of which 44 million tons was measured reserves.

Table 5 shows consumption of coal during 1977 by the various industrial sectors. The steel industry consumed 203,000 tons of coke. The Ministry of Mines and Energy projected that to meet the growing demand of these sectors, 6.1 million tons of coal would be required in 1980, 10.9 million tons in 1985, and 13.1 million tons in 1990.

Carbones de Colombia S.A. (CARBOCOL), a State-controlled company formed in 1976, continued plans to develop Area A of the Cerrejón coal basin located in the Department of La Guajira. Initial production at the rate of 350,000 tons per year, using labor-intensive methods, was expected by the end of 1978, to be used domestically to replace fuel oil in cement production. Area A is estimated to have 120 million tons of reserves exploitable by open pit methods and 300 million tons exploitable by deep shaft. The Cerrejón coal appears to be a low-sulfur (less than 0.5%) steam coal; volatile matter ranges from 38% to 42%; fixed carbon is 54% to 56%; and the calorific value is 13,500 Btu per pound.

International Petroleum (Colombia) Ltd. (INTERCOL), Exxon Corp.'s Colombian subsidiary, continued its drilling program in the larger Area B of the Cerrejón Basin, under a joint venture with CARBOCOL. INTERCOL started drilling in December 1976 and was expected to select a mining site after 3 years under the association contract. If feasibility studies are favorable, the preliminary target date for initial coal output of 1 million tons per year would be 1981. Area B is estimated to have 300 million tons of reserves minable by open pit and another 1 billion tons requiring underground mining. Alternative export transportation routes to the Atlantic coast were

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Table 6.—Colombia: Petroleum production, domestic demand, and exports

(Thousand 42-gallon barrels)

Year	Production	Demand	Exports
1930	20,350	910	19,440
1940	25,590	2,530	22,840
1950	34,060	6,530	26,650
1960	55,770	19,910	31,330
1970	79,594	39,610	31,710
1971	78,101	42,540	25,030
1972	71,674	44,780	15,500
1973	66,844	48,510	9,500
1974	60,867	53,130	470
1975	57,259	57,700	--
1976	53,376	59,560	(1)
1977	50,221	61,580	(2)

[1]Imports of 6,725,000 barrels were recorded.
[2]Imports of 9,399,000 barrels were recorded.

Source: Urrutia, M. Bases para un Plan Energético Nacional. Ministry of Mines and Energy (Bogotá). 1977, p. 38.

Table 7.—Colombia: Petroleum production, by company

(Thousand 42-gallon barrels)

Company	1976	1977	Percent change
Texaco-Petrorio[1]	12,283	10,693	-13
Empresa Colombiana de Petróleos (ECOPETROL)	9,680	9,095	-6
International Petroleum (Colombia) Ltd. (INTERCOL)[2]	6,046	5,399	-11
Texas Petroleum Co	5,409	5,337	-1
Shell-Condor S.A.	5,885	5,128	-13
Petróleos Colombo-Brasileros S.A.	r2,852	4,274	+50
Chevron Petroleum Co. of Colombia	4,222	3,701	-12
Colombian Petroleum Co.[3]	4,408	3,699	-16
Colombia-Cities Service Petroleum Corp. (COLCITCO)[4]	1,588	1,645	+4
ECOPETROL/Farmland International Energy Co.	r605	694	+15
Antex Oil & Gas Co., Inc	398	373	-6
Aquitaine Colombia S.A	--	184	XX
Total	r53,376	50,222	-6

XX Not applicable.
[1]Operates the Orito field (Putumayo); owned 50% each by Texaco Inc. and Petrorio. Petrorio in turn is owned 50% each by ECOPETROL and Cayman Corp.
[2]An Exxon Corp. affiliate.
[3]Owned by South American Gulf Oil Co.
[4]Owned 25% each by COLCITCO, ECOPETROL, Amoco Colombia Oil Co., and Arco Colombia Oil Corp.

under study.

The coking coal of the central region was being explored by Spain, Romania, and Brazil under bilateral agreements. Another coal deposit that CARBOCOL is interested in developing with foreign participation is the San Luis deposit near Santander, which has an estimated 180 million tons of reserves. CARBOCOL has invited foreign companies to begin initial talks regarding prefeasibility studies.

Natural Gas.—Gross production of natural gas increased to a new record high in 1977 of 122 billion cubic feet. Of the total, 50% was used by industry, 8% was used as fuel, 21% was flared, and 18% was reinjected. In August, Promisgas S.A., with ECOPETROL and Texas Petroleum Co. as major shareholders, inaugurated a 380-kilometer pipeline from the Ballena gasfield in La Guajira Department to Cartagena. Gas reserves in the three La Guajira fields of Ballena, Chuchupa, and Ríohacha were estimated at 3.5 trillion cubic feet, 90% of the country's total. In addition to supplying the energy needs of industries in the Barranquilla-Cartagena area, the Government was planning to use the La Guajira nonassociated gas for electrical generation, an LNG plant at Palomino, and an ammonia and urea complex. Following an invitation for bids by ECOPETROL and Texaco Inc. in early 1977, El Paso Co. signed a letter of intent for the development of the 150-million-cubic-foot-per-day La Guajira LNG plant. Exports of LNG, mostly to the U.S. eastern seaboard, were projected to eventually reach $130 million. In December 1977, distribution of consumer gas was initiated in Barranquilla, the fourth largest city in Colombia.

At yearend, Colombia's total natural gas reserves in eight known gasfields were estimated at 3.9 trillion cubic feet. The poten-

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Table 8.—Colombia: Salient statistics of the petroleum and natural gas industries

(Thousand 42-gallon barrels unless otherwise specified)

	1974	1975	1976	1977
Petroleum:				
Production	60,867	57,259	53,376	50,222
Imports	(1)	--	6,725	9,399
Refinery products:				
Refinery throughput (production)[2]	60,093	57,685	59,084	60,364
Exports: Residual fuel oil	11,162	8,691	8,767	8,621
Imports:				
Gasoline	200	1,773	2,652	3,464
Distillate fuel oil, lubricants, other	82	271	r71	300
Total	282	2,044	r2,723	3,764
Consumption:[3]				
Motor gasoline	21,150	21,559	22,928	23,998
Kerosine	3,306	3,330	3,200	3,103
Jet fuel	2,111	2,292	2,598	2,899
Fuel oil	8,681	8,691	8,767	9,058
Diesel oil	7,049	7,391	7,568	7,856
Other	9,342	2,782	3,111	2,893
Total	51,639	46,045	48,172	49,807
Natural gas:				
Gross production, million cubic feet	116,634	120,754	117,924	122,325
Consumption[4], do	65,792	65,905	66,715	74,217
Flared, do	19,604	24,580	25,679	26,211
Reinjected, do	31,238	30,269	25,530	21,897

[1]Exports of 470,000 barrels were recorded.
[2]Total input includes crude runs to stills plus runs of unfinished oils, topped crude, and natural gas liquids blended at refineries.
[3]Revised data; exclude liquefied petroleum gas and aviation and bunker sales to international carriers.
[4]Includes gas used by oil companies for fuel.

tial of the gas deposit discovered in summer of 1977 by the ECOPETROL/Texaco/Amoco Colombia Oil Co. group offshore Cartagena was being evaluated. With the completion of the Ballena-Cartagena pipeline, Colombia's gas pipeline system totaled 1,456 kilometers with a capacity of 644 million cubic feet per day.

Petroleum.—Colombia ranked seventh among Latin American crude oil producers, preceded immediately by Brazil and Ecuador. Production of crude petroleum, which averaged 138,000 barrels per day, decreased for the seventh consecutive year since the peak year of 1970 when 80 million barrels was produced. The Orito field in Putumayo continued as the largest single crude oil producer. However, the Middle Magdalena Basin accounted for nearly one-half of overall output. The new prices established by the Government for marginal crude oil resulted in additional production of 19,500 barrels per day and new production of 2,300 barrels per day. Production from established oilfields declined 12% to 115,000 barrels per day. The petroleum industry projected that production from old fields would continue to decline through 1980 at a rate of 10% per year but that marginal crude oil production would increase 15% per year. Increased exploration activity may change the outlook by the early 1980's so that Colombia may become self-sufficient again in 1985. As of December 1977, Colombia's proved oil reserves were estimated at 980 million barrels. A study by ECOPETROL indicated that Colombia has possible recoverable oil reserves of 7 billion barrels in 13 sedimentary basins; however, 75% of the structures still await test drilling.

For the third consecutive year, domestic demand for crude oil in 1977 exceeded Colombia's output, making it necessary to import 9.4 million barrels—this is in contrast to 1970 when 32 million barrels of crude was exported. The value of crude oil imports increased 55% to $131 million, and that of refinery product imports increased 46% to $56 million. The negative impact of these imports on Colombia's trade balance was moderated in 1977 by exports of 8.6 million barrels of residual fuel oil valued at $105 million. Imports of crude oil were projected at 21 million barrels in 1978, 44 million barrels in 1979, and 63 million barrels in 1980.

Consumption of petroleum products increased only 3.4% in 1977. The low growth resulted from a sluggish economic recovery and increased prices. The price of regular gasoline was raised 250% but remained below the marginal cost of crude oil. Regu-

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lar gasoline was priced at $0.27 per gallon, compared with $0.83 in Argentina, $0.91 in Chile, and $1.51 in Brazil. Only Venezuela and Ecuador had lower prices.

The pricing policy for new and incremental crude oil production adopted by the Government in May 1976 stimulated renewed interest in exploration in Colombia. The number of exploration wells drilled increased to 30 from 17 in 1976, and 50 exploration wells were planned for 1978. During 1977, ECOPETROL, formed in 1951, signed eight new association "risk" contracts, which replaced the concession system, for a total of 70 contracts signed since 1955; at yearend, however, only 28 contracts were active.

The Government decided to postpone construction of the 70,000-barrel-per-day refinery at the Pacific port of Tumaco, the terminus for the trans-Andean pipeline from Putumayo. Colombia's gasoline shortage was expected to be alleviated but not eliminated when expansion of the Barrancabermeja refinery to 140,000 barrels per day is completed.

Uranium.—In October 1977, a new State company was formed, Empresa Colombiana de Uranio (COLURANIO), based in Bucaramanga (Santander), to explore, develop, and market the country's uranium resources. The shareholders of COLURANIO comprised ECOPETROL, the Instituto de Asuntos Nucleares de Colombia (IAN), ECOMINAS, INGEOMINAS, Corp. Eléctrica de la Costa Atlántica (CORELCA), and the Instituto de Interconexión Eléctrica, the company in charge of constructing a national electric grid system.

During 1977, IAN (created in 1955) signed contracts with Empresa Nacional del Uranio S.A. (ENUSA) of Spain and Minatome S.A. of France covering exploration for uranium in several departments. In the contracts, IAN has 51% participation, with the foreign company holding 49%. COLURANIO was expected to take over management of the exploration contracts arranged by IAN.

Cía. Minera de Uranio, the only private enterprise exploring for uranium under an association contract, found a uranium deposit at California (Santander) with reserves of 150,000 tons of ore. By 1980, Colombia expects to be producing 1,000 tons per year of uranium concentrate. Since natural gas, coal, and hydroelectric power are cheaper sources of energy in Colombia, electrical generation by nuclear plants was not expected until the year 2000. Nevertheless, the development of any uranium potential would provide Colombia with another energy option for the longer term.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Colombian pesos (Col$) to U.S. dollars at the rate of Col$38.00=US$1.00, the official exchange rate as of December 1977.

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The Mineral Industry of Cyprus

By T. John Rowland, Jr.[1]

The Island of Cyprus remained divided into two sections in 1977, as it has been since hostilities ceased in 1974. The Federated Turkish Cypriots (FCS) occupied the northern sector, and the Government of Cyprus controlled the southern sector. Information concerning the mineral industry of the FCS sector was not available; as a result, this chapter is based on the Cypriot Government's reports.

The mineral industry in 1977 consisted of the production of chromite, copper, asbestos, bentonite, cement, mineral pigments, and pyrite. The considerable decline in mineral exports caused by the 1974 hostilities led to a diversification of the Cypriot mineral industry. Increased emphasis was applied to exploration and exploitation of nonmetallic minerals. Concurrently, the Geological Survey Department (GSD) extended aid to the Government and private industry for the revitalization of the construction materials industry, including investigation of limestone, clay, barite, and diabase deposits. Revitalization of the construction industry resulted in a shortage of aggregates, especially sand. The Mineral Deposits Section of the Department of Mines investigated various occurrences of diabase for the location of rock suitable for production of crushed aggregate. Exploration revealed four areas: Monagvovilli, Pareklisha, Phikardhou, and Gourri.

Exploration work for locating massive new cupriferous sulfide deposits consisted of an intensive program begun by Noranda Exploration (Cyprus) Ltd. in collaboration with the GSD and Hellenic Mining Co. Ltd. (HMC). A geophysical and geochemical survey was conducted over areas covered by the mining leases and property permit of HMC, requiring an expenditure of $396,000.[2]

The GSD stated that 122 new quarry licenses were granted covering sand and gravel, marble, gypsum, limestone, pigments, and clay. During the year, 8 new prospecting permits were issued, 96 were extended, and 22 were canceled. There was only one oil exploration licence in force, for an onshore area of 310 hectares.

HMC planned to construct a fertilizer complex at Vasilikos on the southern coast of Cyprus. The facility, scheduled to be completed in 1979, is to include production units for sulfuric acid, phosphoric acid, and nitrogen-phosphorus-potassium (NPK) fertilizers. The sulfuric acid plant, to be built by the U.S.S.R., will have a capacity of 180,000 tons per year and will utilize imported phosphate rock. The Lurgi Group of the Federal Republic of Germany was contracted to design the 4,000-ton-per-year phosphoric acid plant and the 150,000-ton-per-year NPK fertilizer plant.

PRODUCTION AND TRADE

Mineral production in Cyprus in 1977 was generally similar to that of 1976. Production increases were recorded for asbestos (6%), chromite (55%), sand and gravel (57%), and umber (35%), while decreases of 15% were recorded for both iron pyrite and copper concentrates. Cyprus Petroleum Refinery Ltd. (CPR) operated near capacity throughout the year.

Mineral commodity exports represented

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about 7.6% of the total value of exports of the Island. In 1977, mineral exports totaled 257,360 tons, increasing 5.3% over the 1976 tonnage, but the monetary value of the exports decreased 3.3% as a result of world economic conditions. The tonnage of iron pyrite exports increased 13.9%. Copper pyrites were not exported in 1977. Exported copper concentrates decreased 33% in tonnage and 47% in value. Asbestos fiber exports increased 7.6% in tonnage and 33% in value. Chromite exports increased 28% in value but only 6% in tonnage.

Table 1.—Cyprus: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Chromium ore and concentrate, marketable	27,623	9,156	14,231
Copper, mine output, metal content[2]	9,872	8,000	6,800
Zinc, mine output, metal content	--	867	179
NONMETALS			
Asbestos	31,602	34,518	36,684
Cement, hydraulic thousand tons	[r]612	1,026	1,071
Clays, crude:			
Bentonite	12,193	5,080	13,200
Other:			
For brick and tile manufacture thousand tons	120	102	132
For cement manufacture do.	196	171	444
Gypsum:			
Crude	22,991	54,379	733,312
Calcined	4,929	10,241	10,544
Lime, hydrated	27,082	31,902	28,262
Pigments, mineral:			
Terre verte[3]	3	--	--
Umber	4,489	20,300	27,400
Yellow ocher	[3]217	[3]844	305
Pyrite ore and concentrate, marketable:			
Gross weight:			
Cupreous	126,290	119,281	NA
Other	79,133	79,019	NA
Total	205,423	198,300	[3]168,861
S content:			
Cupreous	59,200	55,806	NA
Other	39,435	39,194	NA
Total	98,635	95,000	[3]80,898
Salt, marine	4,432	3,318	--
Stone, sand and gravel:			
Crushed and broken stone:			
Havara	655,352	792,500	812,800
Limestone:			
For cement manufacture	457,251	712,166	865,458
Other	5,527	4,771	4,567
Marl for cement manufacture	551,060	651,537	685,901
Unspecified building stone	48,872	44,700	46,700
Dimension stone, marble	22,150	28,450	34,500
Sand and aggregate thousand tons	1,568	2,134	3,353
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	517	644	793
Jet fuel and kerosine do.	122	281	296
Distillate fuel oil do.	772	748	910
Residual fuel oil do.	463	790	861
Other:			
Liquefied petroleum gas do.	139	155	204
Asphalt do.	79	78	97
Unspecified do.	329	1	--
Refinery fuel and losses do.	167	179	119
Total do.	2,588	2,876	3,280

[p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, a variety of other crude construction materials are also produced, but information is inadequate to make reliable estimates of output levels.

[2]Includes the nonduplicative sum of Cu content of all exportable products, including copper concentrates, cupreous pyrites, cement copper, and copper precipitates.

[3]Exports.

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Table 2.—Cyprus: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal, scrap	155	159	NA.
Chromium ore and concentrate	28,126	12,343	Austria 6,368; West Germany 2,501; United Kingdom 1,900.
Copper:			
Concentrate	39,311	42,520	U.S.S.R. 23,102; Spain 17,318.
Cupreous pyrite	19,778	--	
Metal scrap	238	159	United Kingdom 47; West Germany 45.
Gold ... value	--	$15,841	NA.
Iron and steel metal:			
Scrap	6,203	5,068	Italy 4,252; Greece 688.
Semimanufactures:			
Bars, rods, angles, shapes, sections	--	125	NA.
Universals, plates, sheets	--	133	NA.
Hoop and strip	--	2	NA.
Tubes, pipes, fittings	154	231	NA.
Lead metal, scrap	233	--	
Tin metal, scrap	--	660	NA.
Zinc metal, scrap	--	29	NA.
NONMETALS			
Asbestos, crude	28,378	33,552	United Kingdom 7,162; Denmark 4,986; Greece 4,544.
Cement	466,504	732,964	Syria 492,128; Lebanon 140,840; Saudi Arabia 55,971.
Clays and clay products: Clay and other refractory materials	11,512	6,720	Israel 5,936; Dubai 365.
Gypsum and anhydrite	20	11,208	Kenya 6,631; Mozambique 2,500; Kuwait 1,522.
Lime, hydraulic	--	98	NA.
Pigments, mineral, natural, crude	4,429	10,581	United States 6,568; United Kingdom 2,130.
Pyrites, unroasted	408,633	146,853	Greece 102,132; Italy 32,120; Turkey 12,601.
Stone, sand and gravel:			
Dimension stone, crude and partly worked, calcareous	241	123	NA.
Gravel and crushed rock	110	76	NA.
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline, motor ... thousand 42-gallon barrels	--	307	All to Lebanon.
Liquefied petroleum gas ... do	--	(1)	Do.
Lubricating oil ... do	--	5	Mainly to Lebanon.

NA Not available.
[1]Less than 1/2 unit.

Table 3.—Cyprus: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum metal including alloys, all forms	767	1,385
Copper:		
Sulfate	--	70
Metal including alloys, all forms	149	208
Gold metal, including platinum-plated, unwrought and semimanufactures ... troy ounces	11,020	17,135
Iron and steel metal:		
Scrap	1	--
Pig iron, ferroalloys, similar materials	568	573
Steel, primary forms	14	3
Semimanufactures:		
Bars, rods, angles, shapes, sections	8,035	39,378
Universals, plates, sheets	6,251	10,590
Hoop and strip	186	87
Rails and accessories	2	(1)
Wire	686	2,117
Tubes, pipes, fittings	7,218	13,246
Castings and forgings, rough	21	20
Lead:		
Oxides	8	344
Metal including alloys, all forms	79	114
Manganese oxide	--	14
Nickel metal including alloys, all forms	7	9
Platinum-group metals, unwrought and partly worked, but not rolled ... troy ounces	10	4
Silver metal, unwrought or partly worked ... do	115,250	298,218
Tin metal including alloys, all forms	469	379

See footnotes at end of table.

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Table 3.—Cyprus: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS —Continued			
Titanium oxides		111	219
Zinc:			
Oxide and peroxide		2	4
Metal including alloys, all forms		36	13
Other:			
Ores and concentrates of base metals		1	--
Nonferrous metal scrap		2	--
Oxides of metals		1	(1)
Base metals including alloys, all forms	value	$6,676	$2,949
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc		--	22
Dust and powder of precious and semiprecious stones	value	$43	--
Grinding and polishing wheels and stones	do	$61,258	$80,970
Barite and witherite		3	--
Cement		2,470	4,486
Chalk		395	763
Clays and clay products (including all refractory brick):			
Crude		140	191
Products:			
Refractory (including nonclay brick)	value	$885,731	$511,248
Nonrefractory	do	$411,838	$691,123
Diamond, gem, not set or strung	do	$16,289	$42,988
Diatomite and other infusorial earth		90	83
Fertilizer materials:			
Crude:			
Nitrogenous		21	--
Phosphatic		6	--
Manufactured:			
Nitrogenous		12,744	17,084
Phosphatic		2,208	2,401
Potassic		1,225	270
Other, including mixed		28,616	28,947
Ammonia		16	20
Gypsum and plasters		31	61
Lime		2,838	--
Mica, worked, including agglomerated splittings	value	$342	--
Pigments, mineral:			
Natural, crude		127	61
Iron oxides, processed		20	16
Precious and semiprecious stones, except diamond:			
Natural	value	r$6,839	$12,220
Manufactured	do	$10,389	$15,081
Salt and brine		505	504
Sodium and potassium compounds, n.e.s.:			
Caustic soda		363	371
Caustic potash and sodic and potassic peroxides		(1)	3
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked		292	459
Worked	value	$15,656	$19,983
Gravel and crushed rock		205	203
Sand, excluding metal bearing		22	199
Sulfur:			
Elemental, other than colloidal		1,581	2,518
Sulfur dioxide		102	86
Sulfuric acid, including oleum		205	320
Talc, steatite, soapstone, pyrophyllite		213	297
Other, crude	value	$2,974	--
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		152	--
Coal, bituminous, and anthracite		101	79
Coke and semicoke		110	40
Peat, including peat briquets and litter		261	343
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	2,648	2,940
Refinery products:			
Gasoline, including natural	do	157	375
Kerosine and jet fuel	do	4	63
Distillate fuel oil	do	45	261
Residual fuel oil	do	1,426	1,164
Lubricants	do	22	40
Other:			
Liquefied petroleum gas	do	151	168
Mineral jelly and wax	do	1	2
Bitumen and other residues and bituminous mixtures, n.e.s	do	93	4
Unspecified	do	(1)	(1)
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	value	$5,560	--

rRevised.
1Less than 1/2 unit.

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COMMODITY REVIEW

METALS

Chromite.—HMC operated two chromite mines and remained the sole chromite producer in Cyprus. The Kokkinorotsos mine recorded an output of 27,500 tons of ore, from which 13,619 tons of chrome concentrates was produced. The other chromite mine, Kannouves, extracted 1,000 tons of ore, which yielded 612 tons of concentrates. Essentially all of the chrome concentrates were exported to Europe.

Copper.—Three companies were engaged in copper production during 1977. Cyprus Sulphur & Copper Co. Ltd. continued operation at the Limnia open pit mine and produced about 12,800 tons of copper concentrates of 23.3% copper. HMC operated four copper mines with a total production of 14,800 tons, a 92% increase over 1976 output. Kampia Mines Co. terminated operations at its Peristeria copper-zinc mine but planned to resume operations after installation of a concentrator for low-grade ore.

Noranda, in association with the GSD and HMC, embarked on an intensive exploration program for new cupriferous sulfide deposits near Klirou. Three prospects covering 2,000 hectares were investigated in detail. The results indicated copper-bearing sulfide mineralization. At yearend, the economic potential of these deposits was under intensive investigation.

NONMETALS

Asbestos.—Production of chrysotile by Cyprus Asbestos Mines Ltd. (CAM) increased 12% over that of 1976. CAM milled over 2,333,000 tons of ore to produce about 18,000 tons of long-fiber and 14,160 tons of short-fiber asbestos. The United Kingdom, Denmark, Greece, and Ireland were the principal importers of Cypriot asbestos.

Barite and Celestite.—A small deposit of barite and celestite was located near the village of Maroni. Detailed mapping, geophysical prospecting, and drilling operations were conducted on the deposit and surrounding area. Results of the investigation were not published by yearend.

Cement.—Cyprus Cement Co. Ltd. and Vassiliko Cement Works Ltd. were the principal cement producers in 1977. Cyprus Cement operated a quarry and plant. A total of 583,000 tons of white and yellow marl was quarried, along with lesser amounts of soft marl and havara. Clinker production totaled 330,000 tons, and cement output totaled 347,000 tons. Vassiliko quarried over 865,000 tons of limestone and 444,000 tons of clay. Production included 660,000 tons of clinker and 676,000 tons of cement. About 38% of the cement was sold locally.

Clays.—*Bentonite.*—Extensive exploration and laboratory work was conducted by the GSD on various occurrences of bentonite in Cyprus. Exploration included sinking 108 drillholes which verifed extensive bentonite reserves in the area of Phinikaria, Kannaviou, and Sotira. Laboratory investigations were continuing after promising preliminary results.

Mineral Pigments.—The 1977 production of umber increased 35% and production of ocher decreased 31% from 1976 levels. Estimated exports of umber were 9,900 tons, and exports of yellow ocher were 250 tons. The United States and the United Kingdom were the main recipients of umber.

Pyrite.—Production of iron pyrite decreased 15% in 1977. HMC produced iron pyrite with an average sulfur content of 46.5% at the Mathiati mining operation. New discoveries of iron pyrite were not reported during the year.

MINERAL FUELS

CPR operated a refinery on the southern coast at Larnaca, owned by Mobil Oil Corp. (34%), Shell Oil Co. (25.5%), British Petroleum Co. Ltd. (25.5%), and the Cypriot Government (15%).

Crude oil imports amounted to 2,568,180 barrels, supplied by Iraq (68%), Algeria (24%), Saudi Arabia (5%), and Libya (3%). Refinery output was consumed domestically and included jet fuels, 260,000 tons of fuel oils, and other products.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Cypriot pounds (£C) to U.S. dollars at the rate of £C1 = US$2.44.

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The Mineral Industry of Czechoslovakia

By Tatiana Karpinsky[1]

Czechoslovakia is one of the most industrialized countries in Europe, but its mineral resources are limited. The economy continued to experience slow overall growth in 1977. The 1977 national income increased 4.5% over that of 1976[2] to an estimated 438 billion Czechoslovak Korunas (Kcs).[3] The State plan had envisaged an increase of 5.2%.[4] The slower rate of national income growth was due to shortcomings in building construction, and transportation.

In 1977, the gross industrial production increased 5.7%, 0.4% over the target set in the annual State plan; it contributed about 67% of the national income, of which the mineral industry (mining and quarrying) contributed 5.8%. The share of coal production was 4.3%; crude petroleum, 0.1%; metal ores, 0.7%; and other mining, 0.7%.

Compared with 1976 figures, the following increases in mineral production were reported in 1977: Brown coal 4.4%, crude steel 2.5%, rolled steel products 1.9%, petroleum products 7.4%, nitrogenous and phosphatic fertilizers (nutrient content) 6.6% and 3.5%, respectively, and cement 2.1%. Bituminous coal production decreased slightly. Production of electric energy increased 5.8%. Small amounts of copper, lead, tin, tungsten, and zinc were mined locally, with some increase in production. The bulk of nonferrous metals was imported, mainly from the U.S.S.R.

A major problem for Czechoslovakia is its reliance on imports of energy and raw materials, both of which are in short supply. However, there are large reserves of antimony, brown coal, kaolin and other clays, graphite, limestone, magnesite, mercury, uranium, and building materials in the country.

In 1977, Czechoslovakia continued to participate in the expansion of iron ore and nonferrous metals extraction and processing in the U.S.S.R. and continued to supply the U.S.S.R. with equipment for strip mining, transporting, and dressing of ores.[5] In return, Czechoslovakia is to obtain additional deliveries of Soviet aluminum, copper, iron ore, concentrates, and lead.

In 1977, the following major new facilities were put into operation in Czechoslovakia: The Chabrovice coal open pit, blocks 1 and 2 of the Pocerady 11 powerplant, block 1 of the Chvaletice powerplant, and new facilities at the Kladno steel plant.

In view of the difficult situation in the supply of domestic fuels, Czechoslovakia was intensively developing its nuclear power industry. In this regard, Czechoslovakia relies on the cooperation of the U.S.S.R. and other Council for Mutual Economic Assistance (CMEA) countries.[6] In 1977, the Klement Gottwald Steel and Engineering Plant in Ostravá continued the development of its nuclear program at the cost of about 600 million Kcs.[7]

It is planned to invest "billions of Korunas" in the mineral industry in order to increase production of nonferrous metals by 1990. This is to include production of antimony, cadmium, copper fluorite, gold, lead, rare-earth elements, silver, tin, wolfram, and zinc. Long-range plans for the development of the mining, processing, and refining of domestic nonferrous metal ores were adopted by the Government.

Government Policies and Programs.—The goals of the 1978 State plan have been set to insure attainment of the objectives of the economic policy adopted by the 15th Congress of the Communist Party of Czechoslovakia.[8] According to the plan, the gross national product is to increase 4.6% in

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1978. Of this total, industry is to contribute 67.0%, construction 10.5%, agriculture 10.5%, and other production sectors 12%. The national income is to increase 5% in 1978. More than 90% of this increase is to be achieved by an increase in labor productivity.

Industrial production is to increase 5%. The plan sets the following growth rates for individual mineral sectors in 1978: Ferrous and nonferrrous industry 3.7%, power 3.9%, engineering 6.4%, and building materials 5.7%.

The manufacture of equipment for nuclear powerplants is to increase 58% and the manufacture of machinery and equipment for strip mining, overburden, and transportation of coal by belt conveyors, is to increase 38%. The following increases are anticipated in the production of selected mineral commodities in 1978:[9]

Crude steel	1.8
Rolled steel products	2.4
Steel pipe	1.1
Cement	4.6
Coal	2.5
Coke	0.2

In capital construction, attention is focused mainly on projects with budget costs that exceed Kcs2 million. According to the plan, major production capacities to be put into operation in 1978 include brown coal, 5.4 million tons; electric power, about 1,000 megawatts; cement, 269,000 tons; and sulfuric acid, 200,000 tons.

To prevent a further increase in the scope of unfinished projects, new capital construction was reduced in all sectors except fuels, power, and chemicals. In addition, increased efficiency was made one of the conditions for the implementation of general plans of development.

PRODUCTION

Coal is important to Czechoslovakia since it is the major industrial fuel. In 1977, output of bituminous coal, lignite, and brown coal was 121.8 million tons, an increase of 2.9% over that of 1976. About 86% of the bituminous coal production came from the Ostravá-Karviná basin. At year-end, development of the new Darkov mine, with projected capacity of more than 2 million tons per year, had started in the basin. About 73% of the brown coal output in 1977 came from the North Bohemian Basin. This basin is the main supplier of fuel to the growing number of large Czechoslovak powerplants.

Production of iron ore in 1977 remained far below the expanding national requirements. In addition, 16 million tons of iron ore was imported during the year, 3.9% more than in 1976. In 1977, output of pig iron, crude steel, and rolled steel products grew at about the same rate as in 1976. One of the main development targets of Czechoslovakia's ferrous metals industry in 1977 was the reconstruction of the Kladno steel plant.

The rapid development in the refining industry was made possible by supplies of crude oil from the U.S.S.R. In 1977, about 17.5 million tons of crude oil was processed, 3.5% more than in 1976.

Production of natural gas increased from 982 million cubic meters in 1976 to 1,001 million cubic meters in 1977. In addition, 7.2 billion cubic meters of gas was imported, mainly from the U.S.S.R. Czechoslovakia reported that it will have the world's largest gas transit system, capable of carrying 53 billion cubic meters of gas, by the mid-1980's. (In 1977, the flow of gas from U.S.S.R. to East and West Germany, Austria, Italy, and Czechoslovakia was estimated at 22 billion cubic meters).

In 1977, the Czechoslovak Government reported that the ore reserves in the country were much larger than had been estimated. It was expected that production of antimony, copper, lead, and zinc will increase considerably after 1980.

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Table 1.—Czechoslovakia: Production of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
METALS				
Aluminum:				
Alumina[e]		100,000	90,000	95,000
Aluminum ingot, primary only		43,321	36,019	36,544
Antimony:				
Mine output, metal content[e]		[r]700	700	750
Metal[e]		[r]1,300	1,300	1,300
Copper:				
Mine output, metal content		[r]10,300	10,500	11,000
Smelter		[r]10,000	11,400	11,000
Refined, including secondary		22,824	22,052	23,067
Iron and steel:				
Iron ore:				
Gross weight	thousand tons	1,773	1,904	1,994
Metal content	do.	532	571	598
Pig iron and ferroalloys:				
Pig iron	do.	9,253	9,339	9,540
Blast furnace ferroalloys	do.	28	2	--
Electric furnace ferroalloys	do.	132	136	175
Crude steel	do.	14,323	14,693	15,064
Steel semimanufactures, including casting and forgings	do.	10,411	10,392	10,588
Lead:				
Mine output, metal content		4,108	4,184	4,242
Metal, including secondary		18,447	19,116	19,015
Manganese ore, gross weight[2]		999	1,099	910
Mercury	76-pound flasks	5,918	5,541	5,308
Nickel metal, primary[e]		1,700	1,700	1,700
Silver	thousand troy ounces	[r]1,190	1,190	1,190
Tin:				
Mine output, metal content		176	180	180
Metal, including secondary		107	120	120
Zinc, mine output, metal content		8,925	9,269	9,368
NONMETALS				
Barite[e]		7,500	7,500	7,500
Cement, hydraulic	thousand tons	9,305	9,552	9,749
Clays, kaolin	do.	526	545	580
Fertilizer materials, manufactured:				
Nitrogenous, nitrogen content		495,627	568,304	604,585
Phosphatic:				
Thomas slag, P_2O_5 content		1,684	--	--
Other, P_2O_5 content		396,436	375,666	388,928
Fluorspar[e]		90,000	90,000	90,000
Gypsum and anhydrite, crude	thousand tons	637	660	682
Lime (quicklime and hydrated lime)	do.	2,953	2,986	3,021
Magnesite, crude	do.	662	654	661
Perlite[e]		10,000	10,000	10,000
Pyrite	thousand tons	149	111	122
Salt	do.	230	244	254
Sodium and potassium compounds:				
Caustic soda	do.	258	293	312
Sodium carbonate, manufacturod	do.	121	119	118
Stone, limestone, other calcareous	do.	21,721	22,812	22,761
Sulfur:				
Native	do.	10	12	5
From pyrite	do.	67	50	55
Byproduct, all sources	do.	61	10	9
Total	do.	138	72	69
Sulfuric acid	do.	1,245	1,240	1,276
MINERAL FUELS AND RELATED MATERIALS				
Carbon black[e]		30,000	30,000	30,000
Coal:				
Bituminous	thousand tons	28,007	28,083	27,788
Brown	do.	83,535	86,838	90,696
Lignite	do.	3,551	3,488	3,354
Total	do.	115,093	118,409	121,838
Coke:				
Metallurgical	do.	9,234	9,007	8,816
Unspecified	do.	1,676	1,886	2,045
Total	do.	10,910	10,893	10,861
Fuel briquets, from brown coal	do.	1,441	1,311	1,255
Gas:				
Manufactured, all types	million cubic feet	278,879	281,566	279,094
Natural, marketed[3]	do.	32,087	34,679	36,222

See footnotes at end of table.

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Table 1.—Czechoslovakia: Production of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS —Continued				
Petroleum:				
Crude:				
As reported	thousand tons	142	131	123
Converted	thousand 42-gallon barrels	963	888	834
Refinery products:[4]				
Gasoline	do.	12,172	13,472	13,490
Kerosine	do.	2,302	2,310	2,612
Distillate fuel oil	do.	28,303	29,556	31,034
Residual fuel oil	do.	52,661	56,404	57,289
Lubricants	do.	2,485	NA	NA
Liquefied petroleum gas	do.	1,485	NA	NA
Asphalt and bitumen	do.	7,842	7,932	7,836
Paraffin wax	do.	126	NA	NA
Total	do.	107,376	109,874	112,711

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, arsenic, feldspar, gold, graphite, uranium, and a variety of additional petroleum products are produced, but information is inadequate to make reliable estimates of output levels.

[2]This material, although reported as manganese ore, is believed to be manganiferrous iron ore with a manganese content of about 17%, and, as such, is not equivalent to materials reported elsewhere as manganese ore, which generally contain 25% Mn or more.

[3]Includes gas produced from coal mines; gross output of natural gas is not reported, but it is believed to exceed reported marketed output by a relatively inconsequential amount.

[4]Data presented are for those products reported in official Czechoslovakian sources and in the United Nations' publications; no estimates have been included for other products or for refinery fuel and losses.

TRADE

In 1977, Czechoslovakia's foreign trade turnover (exports plus imports) amounted to Kcs124,163 million, an increase of 12.7% over that of 1976.[10] Total exports were valued at Kcs60,950 million, an increase of 12.4% over those of 1976. Exports to centrally planned economy countries increased 11.8%; to developed market economy countries, 9.3%; and to developing countries, 31.9%. Tasks in exports to centrally planned economy countries were exceeded, but exports to market economy countries remained below the planned level.

The total value of Czechoslovakia's imports reached Kcs63,213 million in 1977, an increase of 12.9% over the 1976 level. Imports from centrally planned economy countries increased 13%; from the developed market economy countries, 6.6%; and from developing countries, 41.3%.

The balance-of-trade deficit decreased from Kcs3,859 million in 1976 to Kcs2,263 million in 1977. Czechoslovakia's trade balances for 1977 were as follows in million Korunas:

Council for Mutual Economic Assistance countries	-1,711
Other centrally planned economy countries	674
Developed market economy countries	-3,106
Developing countries	1,880
Total balance	-2,263

The trade deficit was mainly owing to a higher deficit in trade with developed market economy countries. In 1977, there were problems in trade with these countries arising from internal economic conditions, particularly in the areas of capacity, assortment, and quality, and the continuing unfavorable movement of prices on foreign markets.[11]

In 1977, exports of machinery and equipment contributed 51% of the total export value; fuels, mineral raw materials, and metals, 16.7%; chemicals products, 5%; construction materials, 2.2%; and other products, about 25%. Machinery and equipment accounted for 39% of the total import value; fuels, mineral raw materials, and metals 28.7%; chemical products 7.6%; construction materials, 0.8%; and other products, 23.9%.

Imports of fuels, mineral raw materials,

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and metals increased 12% in 1977 over those of 1976. In 1977, Czechoslovakia's main imports included 16 million tons of iron ore, 0.8 million tons of pig iron, 1.3 million tons of manganese ores, 0.5 million tons of bauxite, 7,254 million cubic meters of natural gas, 18.3 million tons of crude oil, and 5.6 million tons of bituminous coal.

Czechoslovakia's largest trading partner was the U.S.S.R. Its share of total Czechoslovak imports was 34% in 1977, and its share of total exports was 32%. The U.S.S.R. accounted for 93% of Czechoslovak imports of crude oil, 83% of iron ore, almost 100% of natural gas, and a large quantity of nonferrous metals.[12]

In 1978, the planned increases in exports is 4.8% to centrally planned economy countries and 13% to market economy countries. The trade turnover between Czechoslovakia and the U.S.S.R. is to reach 5,500 million soviet rubles, an increase of 10% over that of 1977. The greatest increase is to be in the trading of machinery and equipment. Imports of Soviet raw materials such as crude oil, natural gas, iron ore, metals, phosphate fertilizers, asbestos, and mining and metallurgical equipment will also be increased.[13]

The German Democratic Republic was Czechoslovakia's second largest trading partner, with a share of about 11% of the total Czechoslovak imports and exports in 1977. Imports from the German Democratic Republic included deliveries of potassium salts, brown coal briquets, and chemical products. Czechoslovakia supplied the German Democratic Republic's industry with bituminous coal, foundry coke, and rolled steel products. The exchange of machinery and equipment amounted to approximately two-thirds of mutual deliveries.[14]

The wide-ranging economic cooperation between Poland and Czechoslovakia led to considerable increase in their mutual trade turnover in 1977. Czechoslovakia's exports to Poland increased 9.4%, and imports from Poland increased 6.6%. Poland supplied Czechoslovakia with bituminous coal, copper, zinc, sulfur, sulfuric acid, and nonferrous rolled metals. Czechoslovakia's deliveries included kaolin, magnesite for the brick and steel industries, cement, petroleum products, and chemical raw materials. Many branches of Poland's industry utilize the imported Czechoslovak machinery and equipment.

In 1977, Czechoslovakia exported machinery and other capital goods to Cuba and imported nickel and some copper from Cuba. Czechoslovakia, together with other CMEA countries, cooperated on the construction of a nickel and cobalt extraction and processing plant at Camarioca in the Matanzas Province, Cuba. This plant is to go into partial operation in 1981, and 2 years later is to produce 30,000 tons per year of nickel.[15]

An agreement between Czechoslovakia and the People's Republic of China on the exchange of goods and on payments for 1978 was signed in 1977. Under this agreement, Czechoslovakia will supply China with a variety of machinery and equipment and will import from China nonferrous metals and consumer goods.[16]

In 1977, Czechoslovakia participated in geological prospecting in Mongolia, Cuba, and other developing countries. Nearly 100 Czechoslovak experts were working in cuba, most in mining and geology.

The trade agreement between Czechoslovakia and Iran, signed on May 13, 1977, provided for mutual trade in 1977-78. Under this agreement, Czechoslovakia will export machinery and equipment to Iran, and import crude oil and nonferrous ores, and concentrates from Iran.

Table 2.—Czechoslovakia: Exports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal, including alloys:			
Scrap	2,467	3,087	West Germany 979; United Kingdom 856; Austria 852.
Unwrought and semimanufactures	11,629	8,447	West Germany 2,552; Japan 2,187; Italy 1,139.
Copper:			
Ore and concentrate	--	733	All to United Kingdom.
Metal including alloys:			
Scrap	454	752	West Germany 672.
Unwrought and semimanufactures	4,919	6,578	West Germany 4,608; Poland 1,945.
Iron and steel:			
Ore and concentrate	56,995	22,976	All to Austria.

See footnotes at end of table.

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Table 2.—Czechoslovakia: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Iron and steel —Continued			
Metal:			
Scrap thousand tons	182	53	Italy 46; Austria 6.
Pig iron do	22	13	Yugoslavia 9; Sweden 2.
Ferroalloys do	21	23	West Germany 12; Austria 4; United Kingdom 3.
Steel, primary forms[2] do	r252	393	Yugoslavia 151; Bulgaria 63; Italy 53; Romania 53.
Semimanufactures:			
Bars, rods, angles, shapes, sections[3] do	1,072	1,123	NA.
Plates and sheets[2]	868	983	West Germany 209; Yugoslavia 100; U.S.S.R. 99; Italy 96.
Hoop and strip[3]	286	240	NA.
Rails and accessories[3]	r15	20	NA.
Wire[3]	101	99	West Germany 14.
Tubes and pipes[2]	458	481	U.S.S.R. 360; West Germany 20.
Castings and forgings[3]	r33	38	NA.
Unspecified[2]	1,056	1,259	NA.
Total	r3,889	4,243	
Lead:			
Ore and concentrate	7,236	7,735	West Germany 4,810; Belgium-Luxembourg 2,925.
Metal including alloys, scrap	--	785	All to West Germany.
Magnesium metal including alloys, all forms	2,607	905	Do.
Nickel metal including alloys, scrap	--	367	Do.
Platinum-group metals including alloys, all forms value, thousands	$831	$695	Do.
Silver metal including alloys, all forms do	--	$1,288	France $711; Italy $514.
Tin ore and concentrate	181	219	West Germany 204.
Titanium oxides	2,918	4,112	Italy 960; United Kingdom 721; France 605.
Tungsten ore and concentrate	205	76	All to West Germany.
Zinc:			
Ore and concentrate	12,729	19,205	Yugoslavia 8,821; Belgium-Luxembourg 6,090; West Germany 4,294.
Oxide	--	440	Austria 170; West Germany 120.
Metal including alloys:			
Scrap	258	321	All to West Germany.
Unwrought	--	146	Do.
Other:			
Ash and residues containing nonferrous metals	53	1,484	Belgium-Luxembourg 846; Austria 377.
Metals including alloys, all forms value, thousands	$633	$678	Japan $282; Spain $155; Yugoslavia $75; West Germany $75.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum	--	52	All to Hungary.
Powder of semiprecious and precious stones value, thousands	--	$95	Belgium-Luxembourg $90.
Grinding and polishing stones	--	242	West Germany 143; France 48; Italy 48.
Barite	--	1,494	All to Austria.
Cement, hydraulic[2] thousand tons	106	188	West Germany 57; Austria 50.
Clay and clay products:			
Crude:			
Kaolin[2] do	296	397	West Germany 93; Poland 86; Yugoslavia 79.
Fuller's earth, chamotte, and products do	--	67	All to Hungary.
Unspecified do	300	82	Mainly to West Germany.
Products:			
Refractory do	71	69	West Germany 31; Sweden 15; Poland 14.
Nonrefractory do	22	20	Austria 6; Yugoslavia 5; West Germany 3.
Fertilizer materials:			
Manufactured:			
Nitrogenous	187,321	118,817	Hungary 64,213; Yugoslavia 34,598; Italy 9,489.
Other, including mixed	750	2,102	Denmark 1,771; West Germany 241.
Ammonia	17,471	667	All to West Germany.

See footnotes at end of table.

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Table 2.—Czechoslovakia: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Graphite, natural	NA	372	All to Yugoslavia.
Lime, calcined	--	10,098	All to Hungary.
Magnesite[2] thousand tons	398	364	Hungary 70; Poland 66; West Germany 64; East Germany 56.
Mica, all forms	89	88	Italy 27; Yugoslavia 24; Spain 14; Austria 13.
Pigments:			
Natural, crude	--	1,813	All to Hungary.
Iron oxides, processed	360	1,336	Italy 900; Yugoslavia 312.
Sodium and potassium compounds:			
Caustic soda[2]	r36,042	32,410	U.S.S.R. 14,854; West Germany 11,332.
Caustic potash	759	1,139	Yugoslavia 385; Italy 360; Austria 286.
Soda ash	21,022	14,135	West Germany 13,635.
Stone, sand and gravel:			
Crushed rock and dimension stone	106,265	133,662	Hungary 99,292; West Germany 34,370.
Sand	142,413	169,565	Austria 95,544; Hungary 74,021.
Sulfur:			
Elemental	--	797	West Germany 767.
Sulfuric acid	57	3,471	West Germany 2,325; Yugoslavia 1,146.
Talc	4,194	4,192	All to Poland.
Other nonmetals, n.e.s.:			
Crude	7,842	5,739	West Germany 5,485.
Slag, dross and similar waste, not metal bearing	31,412	13,719	All to West Germany.
MINERAL FUELS AND RELATED MATERIALS			
Coal:[2]			
Bituminous thousand tons	3,666	3,770	Romania 794; Austria 646; Yugoslavia 585; East Germany 565.
Lignite do	1,683	1,607	West Germany 1,554.
Coke and semicoke[2] do	2,299	2,105	East Germany 754; Romania 445; Austria 442.
Gas, natural million cubic feet	178,303	283	All to Hungary.
Peat	--	537	All to Italy.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	--	17	All to Yugoslavia.
Refinery products:			
Gasoline do	1,346	1,897	West Germany 645; France 462; Hungary 342.
Distillate fuel oil do	1,842	1,477	Switzerland 1,087; West Germany 259.
Lubricants do	29	51	Austria 46.
Other:			
Liquefied petroleum gas do	135	324	France 122; Italy 106; Yugoslavia 67.
Mineral jelly and wax do	21	14	Finland 5; Italy 5.
Nonlubricating oils do	1,234	1,142	West Germany 1,097.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	29,146	29,269	West Germany 19,091; Italy 4,508.

rRevised. NA Not available.

[1]Unless otherwise specified, data are partially or wholly compiled from the 1976 edition of the United Nations Supplement to the World Trade Annual, v. I, as well as official trade statistics of Bulgaria, East Germany, Hungary, Poland, and the U.S.S.R.

[2]Official Czechoslovakian Trade Statistics.

[3]Source: Quarterly Bulletin of Steel Statistics for Europe, 1977 edition, United Nations, New York, 1977.

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Table 3.—Czechoslovakia: Imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite[2] thousand tons	451	477	Hungary 328; Yugoslavia 149.
Alumina	9,083	8,037	Hungary 7,940.
Metal including alloys:			
Scrap	1,913	540	West Germany 296; Austria 244.
Unwrought and semimanufactures[2] thousand tons	93	88	U.S.S.R. 78; Yugoslavia 9.
Cadmium metal including alloys, all forms[2]	307	251	United Kingdom 20; Bulgaria 12; West Germany 10.
Chromium, chromite[2] thousand tons	178	146	U.S.S.R. 110; Albania 24.
Cobalt oxide and hydroxide	--	64	United Kingdom 45; Finland 19.
Copper metal including alloys:			
Scrap	--	441	All from West Germany.
Unwrought and semimanufactures[2] thousand tons	58	63	U.S.S.R. 41; Poland 13.
Iron and steel:			
Ore and concentrate[2] do	14,802	15,400	U.S.S.R. 12,734; Brazil 1,039; India 430.
Metal:			
Scrap do	60	34	West Germany 31; Austria 3.
Pig iron[2] do	1,108	826	U.S.S.R. 821.
Ferroalloys do	115	109	U.S.S.R. 106; Portugal 2.
Steel, primary forms[3] do	r111	323	NA.
Semimanufactures:			
Bars, rods, angels, shapes, sections do	r128	150	Yugoslavia 31.
Plates and sheets do	r210	99	West Germany 22; Austria 8.
Hoop and strip do	13	11	West Germany 4; Austria 2.
Rails and accessories do	r10	10	NA.
Wire do	r4	3	West Germany 1; Austria 1.
Tubes, pipes, fittings do	r72	291	West Germany 275.
Castings and forgings do	r22	15	NA.
Total do	r459	579	
Lead:			
Oxides	4,102	26,461	Austria 24,628.
Metal including alloys, all forms[2] thousand tons	35	36	U.S.S.R. 25; Yugoslavia 6.
Manganese ore and concentrate[2] do	456	448	U.S.S.R. 359; Brazil 30.
Molybdenum metal including alloys, all forms value, thousands	$111	$132	All from Austria.
Nickel metal including alloys, all forms[2]	5,334	8,188	U.S.S.R. 6,686; United Kingdom 613.
Platinum-group metals including alloys value, thousands	$510	$320	United Kingdom $202; West Germany $118.
Silver metal including alloys do	$5,936	$3,148	Netherlands $1,121; Yugoslavia $1,096.
Tin:			
Oxides	21	16	All from West Germany.
Metal including alloys, all forms[2]	3,986	3,859	United Kingdom 1,315; Bolivia 814; Malaysia 580.
Titanium oxides	863	988	West Germany 558; United Kingdom 340.
Tungsten:			
Ore and concentrate	32	343	All from Netherlands.
Metal including alloys, all forms	3	3	Japan 2; Austria 1.
Zinc:			
Oxide	77	125	All from United Kingdom.
Dust (blue powder)	2,965	2,456	Yugoslavia 2,409.
Unwrought and semimanufactures[2] thousand tons	74	63	U.S.S.R. 21; Yugoslavia 19; Bulgaria 5; Finland 5.
Other:			
Ore and concentrate	1,415	1,060	Netherlands 376; United Kingdom 287; Belgium-Luxembourg 254.
Metals:			
Metalloids	[4]2,282	3,449	Netherlands 1,645; Sweden 1,121.
Base metals including alloys, all forms n.e.s	285	318	Japan 205; Finland 50; United Kingdom 45.
Nonferrous metals rolled, n.e.s	8,000	10,000	All from U.S.S.R.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum	429	839	Italy 678; Belgium-Luxembourg 123.
Grinding and polishing stones	396	500	West Germany 189; Austria 134; Italy 101.
Asbestos[2]	43,494	44,750	U.S.S.R. 28,421; Botswana 9,062; Swaziland 3,966.
Barite and witherite	--	170	All from West Germany.

See footnotes at end of table.

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Table 3.—Czechoslovakia: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Boron:			
Crude, natural borates	--	307	All from Netherlands.
Oxide and acid	335	440	All from France.
Cement[2] thousand tons	582	630	U.S.S.R. 464; Romania 118.
Clay and clay products:			
Crude clays, n.e.s	8,207	7,222	Hungary 5,480; West Germany 1,742.
Products:			
Refractory	10,409	15,914	West Germany 7,528; Poland 3,941; France 1,666.
Nonrefractory	2,150	3,464	Italy 2,507; West Germany 646.
Diamond:			
Gem, not set or strung -- value, thousands	$430	$634	United Kingdom $611.
Industrial do	$1,004	$2,186	Belgium-Luxembourg $1,579; Switzerland $582.
Diatomite and other infusorial earth	2,138	777	All from Iceland.
Feldspar and fluorspar	4,834	4,891	Spain 2,074; West Germany 1,099; Yugoslavia 898.
Fertilizer materials, crude and manufactured:[2]			
Nitrogenous (N content) thousand tons	47	57	All from U.S.S.R.
Phosphatic (P_2O_5 content) do	376	347	U.S.S.R. 172; Morocco 51; Jordan 39.
Potassic do	690	634	East Germany 479; U.S.S.R. 155.
Other, including mixed	--	1,499	All from West Germany.
Ammonia	--	10,459	All from Hungary.
Graphite, natural	330	239	All from West Germany.
Gypsum and plasters[2] thousand tons	25	26	East Germany 25.
Lime	27,477	17,854	All from Poland.
Magnesite	900	1,602	Greece 1,250; Austria 352.
Mica, all forms	r198	144	All from France.
Pigments, iron oxides, processed	1,696	675	All from West Germany.
Pyrite[2] thousand tons	11	9	All from U.S.S.R.
Salt	169,076	193,122	U.S.S.R. 129,828; Poland 63,294.
Sodium and potassium compounds:			
Caustic soda thousand tons	r22	16	All from West Germany.
Soda ash[2] do	r206	163	East Germany 66; Romania 42; Bulgaria 30.
Stone, sand and gravel:			
Crushed rock and dimension stone	r33,086	36,029	Hungary 21,374; Yugoslavia 12,789.
Limestone and dolomite	10,387	3,454	All from Poland.
Quartz and quartzite	2,799	5,601	All from West Germany.
Sulfur:			
Elemental, all forms[2] thousand tons	493	477	Mainly from Poland.
Sulfuric acid[2] do	92	39	Poland 22; U.S.S.R. 17.
Other nonmetals:			
Crude	1,059	923	United Kingdom 569; West Germany 191; France 163.
Slag, dross, and similar waste, not metal-bearing, from iron and steel manufacture	--	6,085	All from Austria.
Oxides and hydroxides	337	513	France 327; West Germany 114.
Halogens	--	305	All from France.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black[2]	r31,412	31,567	U.S.S.R. 15,732; Romania 9,966; West Germany 3,654.
Coal and briquets:[2]			
Anthracite and bituminous coal thousand tons	5,188	5,209	U.S.S.R. 2,914; Poland 2,295.
Lignite briquets do	518	454	All from East Germany.
Coke and semicoke do	67	e23	All from U.S.S.R.
Gas, natural million cubic feet	130,452	164,106	U.S.S.R. 163,930.
Petroleum:			
Crude[2] thousand 42-gallon barrels	115,453	125,632	U.S.S.R. 119,923; Iraq 1,833.
Refinery products:			
Kerosine and jet fuel do	7	13	West Germany 5; Yugoslavia 4.
Distillate fuel oil do	81	5	West Germany 3; Yugoslavia 2.
Residual fuel oil do	76	369	Hungary 233; Austria 113.
Lubricants do	4295	311	Austria 280; West Germany 18.
Other:			
Liquefied petroleum gas do	342	367	Austria 366.
Mineral jelly and wax do	7	6	West Germany 5.
Nonlubricating oils do	59	73	West Germany 68.
Petroleum coke do	26	76	All from West Germany.
Unspecified do	--	189	All from Poland.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	494	671	West Germany 495; Italy 176.

e Estimate. r Revised. NA Not available.

[1] Unless otherwise specified, data are partially or wholly compiled from the 1976 edition of the United Nations Supplement to the World Trade Annual, v. I, as well as official trade statistics of Bulgaria, East Germany, Hungary, Poland, and the U.S.S.R.

[2] Source: Official Trade Statistics of Czechoslovakia.

[3] Source: Quarterly Bulletin of Steel Statistics for Europe, 1977 edition, United Nations, New York, 1977.

[4] Partial figure; tonnage not available for all sources.

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COMMODITY REVIEW

METALS

Antimony.—In 1977, the estimated mine production of antimony (metal content) was about 750 tons. Antimony ores were mined at Liptovská Dúbrava and at Pezinok, near Bratislava. Prospecting for antimony ores was planned to start in the near future in the Low Tatras, the Low Carpathians, and the Spis-Gemer Mountains. Preliminary findings show that there will be adequate antimony ores, with even additional export.[17]

Copper.—In 1977, mine production of copper was about 11,000 tons. Production of electrolytic copper amounted to 23,067 tons. Czechoslovakia imported 37,000 tons of copper from the U.S.S.R., 16,000 tons from Poland, 3,000 tons from the United Kingdom, and some from Zambia.[18]

During the 14 years of operation (1962-1976), the Banská Bystrica refinery has produced about 1,500 tons of copper and 4.8 tons of silver, valued at Kcs87 million. In 1977, the Banská Stiavnica and Kodrusa plants produced 220 tons of copper and approximately 0.4 tons of silver in concentrates estimated at Kcs12 million .[19] In 1977, continuous production of copper started on a trial basis at the Krompachy smelter plant.

Czechoslovakia's largest copper deposits are found in the eastern part of the Slovak Ore Mountains and at Zlaté Hory in Moravia. Smaller deposits occur in the Czech Ore Mountains and in Central Bohemia. Slovakia appears to have good prospects with regard to copper mining. It is hoped that new deposits will be found in the existing mining centers of Slovinky, Gelnica, and Hodrusa.

Investigations of ore deposits have proved that Czechoslovakia can raise its production of copper about 100% in the future. Further prospecting for copper is to continue in both the Czech and Slovak Socialist Republics.

Iron and Steel.—In 1977, iron ore production in Czechoslovakia was estimated at 2 million tons. The main ore deposits are located in the Slovak Ore Mountains and in central Czechoslovakia. In 1977, more than 15 million tons of iron ore was imported of which the U.S.S.R. provided 13.3 million tons; Brazil, 896,000 tons; Sweden, 521,000 tons; India, 446,000 tons; and Algeria, 88,000 tons.[20]

Production of pig iron in 1977 increased 201,000 tons, 2.2% over that of 1976 to 9.7 million tons. Pig iron production is planned to exceed 10.5 million tons in 1980. Imports of pig iron in 1977 reached 833,000 tons. In 1977, Czechoslovakia produced 15.0 million tons of crude steel, an increase of 2.5% over that of 1976; the share of oxygen converter steel was 25.3%. Crude steel production is planned to reach 16 million tons in 1980.

Production of rolled steel products in 1977 increased by 196,000 tons over the 1976 level to 10.6 million tons. Foreign trade in crude and semimanufactured steel for 1975-77 was as follows, in thousand tons:

	1975	1976	1977
Exports	3,251	3,400	3,449
Imports	571	909	516

In 1977, employment in the iron and steel industry totaled 181,800 workers and employees. Total investment in the steel industry was Kcs3.7 billion. The largest metallurgical complex, the Klement Gottwald Metallurgical Works in Ostravá-Kuncice, produced more than 3.3 million tons of coke and 2.8 million tons of pig iron in 1977.

In 1977, additional facilities included renovation of a rolling mill and a unit for production of steel sheet for the manufacture of pipes at the Kladno steel plant.

In the remaining years of the sixth 5-year plan period (1976-80), the industry is to complete most of the projects for the nuclear power and pipe production. In addition, the following new projects are to be carried out in 1978: Construction of an oxygen converter plant at Trinec, with a capacity of 2.8 million tons per year of steel; continuous-casting installations at the East Slovak Iron Works; construction of a new medium-grade rolling mill and renovation of some coke batteries at the new Klement Gottwald Metallurgical Works in Ostravá-Kuncice; and a few other projects.[21]

In 1977, Loewy Robertson of the United Kingdom and Czechoslovakia signed the contract for the supply of a seamless-pipe plant to Czechoslovakia. The pipe plant to be constructed at the Chomutov metallurgical complex in 1979, will be the third of its type in the world.

In accordance with an intergovernmental agreement between Czechoslovakia and the U.S.S.R. on cooperation in the field of pro-

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duction and erection of nuclear powerplants, the Vítkovice Steel and Engineering plant at Ostravá-Kuncice, the steel works at Chomutov, the General Engineering Works at Brno, and many other facilities will participate in the manufacture of nuclear equipment for reactors and nuclear powerplants. Skoda Concern, Plzen, was entrusted with the production of the complete reactors.[22] The manufacture of equipment for nuclear power engineering started in 1976.

Lead and Zinc.—Lead-zinc ores are mined at the Príbram, Kutná Hora, and Banská Stiavnica deposits. In 1977, production of lead concentrate totaled 6,973 tons and mine production of contained lead was 4,242 tons. Smelter production was reported at 19,015 tons. Soviet lead deliveries totaled 28,000 tons and Yugoslav deliveries, 2,000 tons in 1977. Production of zinc ore amounted to 777,000 tons and zinc concentrate, 18,736 tons. Zinc mine production was estimated at 9,368 tons. In 1977, imports of zinc from the U.S.S.R. amounted to 21,000 tons; from Yugoslavia, 14,000 tons; from Bulgaria, 3,000 tons; from Finland, 3,000 tons; and from Poland, 1,000 tons.

During 1977, prospecting for polymetallic ores centered in former mining districts (Spania Dolina, Zlatno, and Banská Stiavnica). Some new ore deposits were found in the used pits at the greater depths. Production of lead and zinc in Czechoslovakia is expected to increase 200% and 260%, respectively, by 1980.[23]

Tin.—A new deposit of tin ore (SnO_2) has been discovered in commercial quantity near Medvedí Brook, in the vicinity of Hnilec Village in the Carpathians. The ore vein has a diameter of about 2 to 3 meters. Reserves have been estimated at 2 million tons of tin ore.[24]

In 1977, 3,196 tons of tin was imported, of which 982 tons was from Bolivia, 690 tons from Indonesia, 596 tons from the United Kingdom, 350 tons from Malaysia, and 100 tons from France.

Uranium.—Czechoslovakia is the leading producer of uranium in Eastern Europe. Uranium production is centered at Hamr-na-Jezere in Northern Bohemia, in the Príbram area in Central Bohemia, and in Western Bohemia.

The Czechoslovak uranium industry grew considerably after 1945, when new mines opened in several parts of the country. Uranium production is centrally controlled and headed by the enterprise Czechoslovak Uranium Industry (CSUP), established on the basis of the agreement signed by the Czechoslovakia and Soviet Governments on November 23, 1945. According to this agreement, the U.S.S.R. is supplying machinery and equipment for development of the uranium industry and Czechoslovakia is delivering radioactive raw materials to the U.S.S.R. Soviet-made equipment was used to sink new shafts in the Jachymov area, and later in the Príbram area and other places.

In 1977, the Western Bohemian uranium mines were testing the Soviet-made stope hoists, and the Hamr-na-Jezere uranium mines were testing the Soviet 4-PU cutter-loader combine. Development of chemical plants in the uranium industry was also in progress. This was possible only with Soviet assistance.[25]

Data on uranium ore production are practically nonexistent because such data are classified. The deposits of uranium ore at Hamr-na-Jezere are considered relatively large and are expected to last through several decades of exploitation.[26]

Reportedly, the Príbram unit of the CSUP achieved all planned production and export tasks for the first 6 months of 1977 and attained favorable economic results. Planned exports to the U.S.S.R. were exceeded. Work at the Príbram uranium mine was concentrated at a depth of 1,400 meters.[27]

NONMETALS

Fertilizer Materials.—Czechoslovakia's chemical industry produced 604,585 tons of nitrogen and 388,928 tons of phosphatic fertilizers (nutrient content) in 1977. Production of nitrogenous fertilizers increased 6.0% over that of 1976 and phosphatic fertilizers 3.5%. It is planned to use 268 kilograms per hectare of fertilizer (nutrient content) in 1980 and about 350 kilograms per hectare by 1990.

In 1977, the U.S.S.R. delivered to Czechoslovakia 175,000 tons of phosphates (P_2O_5 content); Morocco provided 45,000 tons; Algeria, 42,000 tons; and Tunisia, Jordan, and Senegal, 45,000 tons. Imports of nitrogenous fertilizers totaling 45,000 tons came from the U.S.S.R. In 1977, Czechoslovakia also imported 627,000 tons of potassic fertilizers, of which about 75% was received from the German Democratic Republic and 25% from the U.S.S.R. There are no plans for any further increases in imports of potassic fertilizers. Problems are occurring in the case of nitrogenous and phosphatic fertilizers, with demand continuing to exceed supply.[28]

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The chemical complex at Sala is the most important nitrogenous fertilizer producer in Czechoslovakia, with a 450,000-ton-per-year ammonia production. Zaluzi is the second most important plant. Other important nitrogen complexes are located at Ostravá, Strázske, and Lovosice. It is planned to start construction of a 449,000-ton-per-year ammonia unit and a 300,000-ton-per-year urea unit, both at Ostravá, northern Moravia.[29]

The country produces an urea-ammonium nitrate solution known as DAM 390. The product is now manufactured at Sala at a rate of 20,000 tons per year. In the future, Czechoslovakia hopes to increase investment in the liquid fertilizer industry.

Phosphatic fertilizers were produced at the chemical complexes at Lovosice (Northern Bohemia), at Prerov (Northern Moravia), Kolin, and at Usti (Central Bohemia), and in Bratislava (Western Slovakia).

It is planned to build six ammonium polyphosphate plants, each with a capacity of 100,000 tons per year, in the near future. At the Foska works in Prostorna, the trial operation of a new thermal phosphoric acid plant was begun. It is expected to reach full capacity in 1979; a liquid nitrogen-phosphorous fertilizer plant is planned to start in 1979.[30]

Fluorspar.—Large deposits of fluorspar are known in the Ore Mountains in northern Bohemia. The recent discovery of new deposits of fluorspar in this area has increased the reserves of fluorite ore considerably. Fluorspar deposits of less significance are located in southern Bohemia. Estimated production of fluorite ore was 90,000 tons in 1977. Czechoslovakia has only one mining enterprise for the production of fluorite concentrate, Sobedruhy, located in the Ore Mountains. Since 1975, the mine and processing plant have been renovated and enlarged.[31] It is expected that by 1985 Czechoslovakia will be self-sufficient in fluorite.

Magnesite.—Magnesite mining and processing is important at Lavinobana and other centers in Central Slovakia. Important deposits of magnesite are also located in the southwestern part of East Slovakia.[32]

Mining and processing of magnesite is increasing constantly. The plans are to increase the capacities of the larger magnesite mines while decreasing the number of small mines, as follows:

Annual capacity (thousand metric tons)	Actual 1977		Planned 1980	
	Number of mines	Ore production (thousand metric tons)	Number of mines	Ore production (thousand metric tons)
0-10	8	73	5	43
10-50	13	450	9	352
50-100	4	275	4	280
100-300	9	2,140	12	2,280
300-500	3	1,500	11	5,400
Over 500	2	2,500	4	4,600
Total	39	6,938	45	12,955

Source: Rudy (Prague). No. 6, 1977, p. 57.

Czechoslovakia is expanding the capacity of the Kosice, Podrecany, Lubeník, Burde-Poproci, and Miková mines. The Slovak magnesite mine at Lubeník produced 495,000 tons of useful ore by November 29, 1977, fulfilling the 1977 plan.

In 1977, 367,000 tons of magnesite was exported, of which 74,000 tons went to Hungary, 21,000 tons to Poland, 58,000 tons to the German Democratic Republic, 57,000 tons to the Federal Republic of Germany, and 38,000 tons to Romania.

MINERAL FUELS

Czechoslovakia's principal primary energy resources are bituminous coal and lignite. Total primary energy production derived from fossil fuel and hydroelectric and nuclear power generation was 86 million tons standard coal equivalent (SCE) in 1977, with coal and coke supplying 98%. Total primary energy consumption was 120.2 million tons SCE, with coal and coke providing about 69.5%, petroleum 20.4%, natural gas

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9.1%, hydroelectric power 0.4%, nuclear power 0.1%, and imported electric power 0.5%. Primary energy balances of Czechoslovakia for 1976 and 1977 are shown in the following table 4.

Table 4.—Czechoslovakia: Supply and apparent consumption of fuels and power

(Million tons of standard coal equivalent[1])

	Total primary energy	Coal (bituminous, brown, lignite) and coke	Crude oil and refinery products	Natural gas	Hydroelectric power	Nuclear power
1976:						
Production	r84.4	82.4	0.2	r1.3	0.4	0.1
Exports	r8.0	6.5	1.5	--	--	--
Imports	r37.6	5.7	r25.1	r6.2	--	--
Apparent consumption	r114.0	81.6	r23.8	r7.5	.4	.1
1977:						
Production	86.0	83.9	.2	1.3	.5	.1
Exports	7.8	6.2	1.6	--	--	--
Imports	42.0	5.8	25.9	9.7	--	--
Apparent consumption	120.2	83.5	24.5	11.0	.5	.1

rRevised.

[1]1 ton standard coal equivalent (SCE)=7,000,000 kilocalories. Conversion factors used are as follows: Bituminous coal, 1.0; brown coal and lignite, 0.6; crude oil, 1.47; natural gas (per 1,000 cubic meters), 1.33; and hydroelectric and nuclear power (per thousand kilowatt-hours), 0.125.

[2]Includes 0.6 million tons SCE of imported electric power in 1976 and 1977.

The tendency to reduce the use of coal and increase the use of electric power generated by nuclear plants is expected to accelerate after 1980. By 1990, nuclear powerplants are expected to provide roughly one-third of the electric power produced in Czechoslovakia.

Coal.—In 1977, production of bituminous coal, brown coal, and lignite reached 121.8 million tons, an increase of 2.9% over that of 1976. The State plan for total extraction was fulfilled. Of the total coal output, bituminous coal accounted for 27.8 million tons and brown coal and lignite for 94.0 million tons. Bituminous coal production declined less than 1%, and brown coal and lignite production increased 4.1%. Bituminous coal production is expected to remain at about 28 million tons during the 1978-80 period. Brown coal and lignite output is expected to reach about 97 million tons in 1980 and 107 million tons in 1990.[28]

In 1977, about 3.3 million tons of bituminous coal was exported, of which Romania received 650,000 tons; the German Democratic Republic, 579,000 tons; Austria, 569,000 tons; Hungary, 543,000 tons; Yugoslavia, 526,000 tons; the Federal Republic of Germany, 162,000 tons; and Belgium-Luxembourg, about 150,000 tons.

In 1977, bituminous coal imports amounted to about 5.6 million tons, of which 3 million tons came from the U.S.S.R. and 2.6 million tons, from Poland.

Coke production in Czechoslovakia has stabilized in recent years at about 11 million tons. Coke exports during 1977 totaled 2.03 million tons. The German Democratic Republic, Romania, Austria, and Hungary were the largest importers. Brown coal exports amounted to 1.65 million tons, and imports were 0.32 million tons in 1977. Most of the brown coal exports went to the Federal Republic of Germany.

In 1977, approximately 55.5 million tons of coal was used for production of electric energy. In December, the Ministry of Fuel and Power estimated that coal reserves would last only into the third or fourth decade of the next century.

Bituminous coal mining in Czechoslovakia is centered in the Ostravá-Karviná Basin (Northern Moravia) and brown coal mining in the Northern Bohemian and the Sokolov Basin.

The output of the Ostravá-Karviná coalfields, most of which is suitable for coking, was 23.7 million tons in 1977. It is expected to reach 24.5 million tons in 1978 and to maintain this level until about 1990. In 1977, about 16 mines were operating and 2 more mines were under development in this basin. Coal-mining conditions over the past decade have become progressively more difficult. Coal production in Czechoslovakia is highly mechanized. In 1977, machine mining of bituminous coal in the Ostravá-Karviná coalfields accounted for 91% of

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total production. Continuous miners produced about 92% of mechanized production and plows, 7%.

In the south of the Ostravá-Karviná Basin, preparations were made for the development of a new mine which is to produce high-quality coking coal at a depth of 800 to 1,200 meters. After 1990, this new output is to replace that of a number of depleted old mines.

Bituminous coal deposits are also located at Kladno (west of Prague), at Plzen, and Rosice. The output of the Kladno mining district accounted for about 8% of the total bituminous coal production in 1977. Mining activity in this distirct will probably be phased out in the 1980's and shifted to the nearby Slany deposits. Recently discovered bituminous coal reserves at Slany were estimated to contain 150 million tons.[34]

The Slany coal deposits will be handed over to the Kladno mining concern by the middle of 1978 to develop the two pilot mines at a depth of over 1,200 meters.

The projected Slany mine is to be the deepest bituminous coal mine in Czechoslovakia. This mine is expected to produce 2.5 million tons of coal per year after 1990.[35] Plans for mining coal in the Slany area are focused in particular on three seams: The Dolín, Luben, and main Kladno seams. Coal seams at Slany are situated in complicated geological and hydrogeological conditions.

Coal reserves at the Slany site guarantee that the working life of coal mines in this area will be approximately 45 years. During 1977-85, other bituminous coal deposits are also to be developed.

In 1977, about 650 Polish workers and engineers were working in Czechoslovia on the construction of a coal transloading station situated near Litomerice (Northern Bohemia). When the station is completed, it will load 35,000 tons per day of coal into barges for the Chvaletice power station and other customers along the Elbe River.[36]

In 1977, 73% of the brown coal output came from the Northern Bohemian Basin. This basin, together with the neighboring Sokolov Basin, represents the largest mining area in Czechoslovakia. Output from the Sokolov Basin was 19.8 million tons (21.8% of total output) in 1977 and is to remain unchanged, whereas output from the Northern Bohemian Basin is expected to rise 66.4 million tons in 1977 to more than 70 million tons in 1980. In the following years, the output of brown coal is to increase to 75 million tons per year.[37] The Northern Bohemian Basin is the only developing basin in Czechoslovakia. In 1980, this basin is to meet 44% and in 1990 about 37% of all energy needs of the country. The Northern Bohemian coal basin is the main supplier of fuel to the growing number of Czechoslovak power stations. The problems of declining coal quality are compounded by greater air pollution by fly ash and sulfur dioxide. The Maxim Gorkiy mine, with a planned annual capacity of 16 million tons of raw brown coal, is the largest open pit in this basin.

In 1978, production of brown coal from four open pits (Bzezno, Merkur, Maxim Gorkiy, and Erika) is to increase 5 million tons. Development of the Vrsany surface mine naer Most, with an annual capacity of 6 million tons, began in 1977.

In 1977, the brown coal and lignite open pits were 100% mechanized; approximately 24% of the coal was mined by power shovels and 76% by rotary excavators. About 21% of the overburden was removed by power shovels, 66% by rotary excavators, and 13% by chain bucket excavators.

Consumption of brown coal in 1976 was as follows: Electric powerplants 48.3%, steam for heating and industrial use 24.6%, railroads 0.8%, households 9.7%, and other 6.6%.

During the 1976-1980 plan period, it is planned to invest Kcs26 billion, a 60% increase over that of 1971-1975, in development of the coal industry. Kcs5 billion alone is to be invested during this period to procure new machinery for brown coal surface mines.

Natural Gas.—Production of natural gas in 1977 was about 1.0 billion cubic meters. Gasfields are located mostly in Southern Moravia (the northern part of the Vienna Basin). In 1977, natural gas imports totaled 7.2 billion cubic meters of which 5.2 billion cubic meters was received from the U.S.S.R. In 1976, Czechoslovakia signed an agreement with Iran that provided for annual imports of 3.6 billion cubic meters of gas for 20 years, starting in 1981. Czechoslovak-Soviet agreements, under which Iranian natural gas will flow by way of the U.S.S.R. to Czechoslovakia and Western Europe, were expected to be signed in Prague in February 1978. The agreements also provide for the construction of the third gas transit pipeline across Czechoslovak territory with a capacity of 17.5 billion cubic meters per year. The third pipeline is to be completed in 1984. With an overall pipeline capacity of about 53 billion

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cubic meters per year of natural gas, Czechoslovakia will become the largest and most significant transporter of natural gas in Europe.

In 1977, Czecholovakia continued to participate in the CMEA project for development of the Orenburg gasfields and building the main pipeline (named Soyz) from Orenburg to the western frontier of the U.S.S.R. The gas obtained in payment for this project will account for most of the increase in natural gas resources in 1979 and 1980.

In 1977, the gas transit pipeline carried about 22 billion cubic meters of Soviet natural gas to Western Europe and Czechoslovakia. The gas pipeline system on Czechoslovak territory totaled 2,238 kilometers.[38]

In 1977, the southern section of the second string of the gas transit pipeline went into operation. In September, an underground gas storage with a capacity of 200 million cubic meters was handed over for use at Lab, near Bratislava.

Petroleum.—Production of crude oil in Czechoslovakia is insignificant and has been declining throughout the 1970's while its consumption has increased steadily. Total proved crude oil reserves were estimated in 1964 at only 2.5 million tons. Czechoslovakia's oil comes mainly from the Gbely and Hodonín fields.

In 1977, Czechoslovakia processed 17.5 million tons of U.S.S.R. crude oil, a 3.5% increase over that of 1976. Soviet deliveries made up some 96% of total crude oil imports. In 1978, crude oil and petroleum products imports from the U.S.S.R. are to increase 4.1% over those of 1977. The annual growth rate of soviet deliveries of crude oil to Czechoslovakia dropped from 13.5% in 1971 to 4.1% in 1977.

In 1977, Czechoslovakia participated in the financing and construction of an oil pipeline running from an Adriatic seaport in Yugoslavia to Czechoslovakia. Czechoslovak organizations were in charge of the construction of a 105-kilometer section across Hungary. The project includes the delivery of pipes, the assembly and laying of pipes, and the construction of four pumping stations and four crude oil storage tanks.[39] The Adriatic line is expected to be operational in 1979, when Czechoslovakia is to receive 5 million tons of crude oil from Africa and the Middle East.

The Czechoslovak refining industry is to be capable of processing 21 million tons of crude oil in 1980: Approximately 6 million tons in Litvínov, 3 million tons in Kralupy, 1 million tons in Pardulice, 300,000 tons in Ostravá, 200,000 tons in Kolin, approximately 9 million tons in the Bratislava Slovnaft enterprise, and 1.5 million tons in Vojany.[40]

A 1976 agreement with Hungary provided for joint oil-prospecting operations along the Danube River at depths of up to 4,000 meters.

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[1]Foreign mineral specialist, Branch of Foreign Data.
[2]Rude Pravo (Prague). Jan. 27, 1978, pp.1-3.
[3]The official exchange rate from Czechoslovak Korunas (Kcs) to U.S. dollars was 5.70Kcs=US$1.00 (May 1977).
[4]Hospadarske Novini. No. 48, Nov. 26, 1976.
[5]Czechoslovak Heavy Industry, (Prague). No. 1, 1978, p. 32.
[6]Includes the following countries: Bulgaria, Cuba, Czechoslovakia, the German Democratic Republic, Hungary, Mongolia, Poland, Romania, and the U.S.S.R.
[7]Page 34 of work cited in footnote 5.
[8]Planovane Hospodarstvi (Prague). No. 1, 1978, p. 1-6.
[9]Hospodarske Noviny, Prague. July 15, 1977, pp. 1, 3.
[10]Czechoslovak Foreign Trade (Prague). No. 5, p. 44.
[11]Rude Pravo (Prague). Apr. 17, 1978.
[12]Bratislava SMENA (Bratislava). Mar. 22, 1978.
[13]Foreign Trade (Moscow). No. 3, 1978, p. 10.
[14]Czechoslovak Foreign Trade (Prague). No. 7, 1977, pp. 10-16.
[15]Czechoslovak Foreign Trade (Prague). No. 3, 1978, pp. 41-42.
[16]Czechoslovak Heavy Industry (Prague). No. 5, 1978, p. 40.
[17]Czechoslovak Foreign Trade (Prague). No. 12, 1977, p. 40.
[18]Czechoslovak Foreign Trade (Prague). No. 2, 1977, p. 61.
[19]Rude Pravo (Prague). Mar. 16, 1978, p. 2.
[20]Chamber of Commerce of Czechoslovakia. Facts on Czechoslovak Foreign Trade. 1978.
[21]Pages 1-3 of work cited in footnote 9.
[22]Czechoslovak Foreign Trade (Prague). No. 6, 1977, p. 20.
[23]Work cited in footnote 17.
[24]Lidove Demokracie (Prague). July 15, 1978, p. 2.
[25]Hornik Energetik (Prague). Nov. 3, 1977, p. 3.
[26]Czechoslovak Foreign Trade (Prague). No. 1, 1977, p. 39.
[27]Hornik Energetik (Prague). No. 31, Aug. 4, 1977, p. 11.
[28]Politicka Eckonomie (Prague). No. 12, 1977, pp. 1069-1085.
[29]European Chemical News, July 15, 1977, p.30.
[30]Phosphorous and Potassium. No. 93, January/February, 1978.
[31]Hornik a Energetik (Prague). Nov. 17, 1977, p. 4.
[32]Czechoslovak Foreign Trade (Prague). July 1976, pp. 30-33.
[33]Rude Pravo (Prague). Dec. 2, 1977.
[34]Planovane Hospodarstvi (Prague). No. 2, 1978, pp. 31-35.
[35]Czechoslovak Foreign Trade (Prague). No. 4, 1978, p. 43.
[36]Page 44 of work cited in footnote 14.
[37]Czechoslovak Foreign Trade (Prague). No. 9, 1977, p. 39.
[38]Rude Pravo (Prague). June 16, 1978, p. 5.
[39]Obchod, Prumysi, Hospodarstvi (Prague). July 1978, p. 51.
[40]Rude Pravo (Prague). Jan. 31, 1978, p. 1.

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The Mineral Industry of Denmark and Greenland

By Joseph B. Huvos[1]

Denmark and Greenland have few mineral resources and must import most fuels and minerals. Production includes some crude oil in the North Sea, diatomite in Denmark, and lead, and zinc in Greenland.

Denmark and Greenland's economy was sluggish in 1977; inflation was 9% and unemployment was 6.5%. The country's balance-of-payments deficit was covered by public borrowing abroad.

The gross national product (GNP) of Denmark and Greenland, reported as a total, was about $41.5 billion in 1977.[2] [3] The Contribution of the principal sectors of the mineral industry to the GNP in 1976 and 1977 and average employment in 1977 are shown in the following tabulation:

Sector	Contribution to GNP (millions)			Average 1977 employment (thousand persons)
	1976[r]	1977	Percent increase	
Base metals	$29	$31	6.9	6.4
Nonmetals	74	81	9.5	17.9
Chemicals	221	228	3.2	21.4
Total	324	340	4.9	45.7

[r]Revised.

Source: Danmarks Statistisk (Copenhagen). Economic Trends. No. 1, April 1978, pp. 28, 32.

Important events in the mineral industry of Denmark and Greenland included two oil and gas finds in the North Sea, continued construction of an iron ore mine in Greenland, and completion of an unsuccessful oil drilling season in Greenland's offshore waters.

PRODUCTION

In 1977, production of most mineral products increased. Production of selected mineral commodities in 1975-77 is detailed in tables 1 and 2.

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Table 1.—Denmark: Production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Iron and steel:			
Iron ore (less than 42% iron) gross weight	13	8	5
Metal:			
Crude steel[2]	559	722	686
Semimanufactures	[r]438	552	[3]560
Lead metal, secondary (including alloys)[1]	13	19	23
NONMETALS			
Cement, hydraulic[1]	2,237	2,355	2,309
Chalk[1] thousand tons	82,920	89,719	124,133
Clays: Kaolin, crude and washed[e] do.	23,000	23,000	23,000
Diatomaceous materials:[e]			
Diatomite	21	21	25
Moler	[r]230	[r]230	230
Fertilizer materials, manufactured, gross weight:[1]			
Nitrogenous	47	59	86
Phosphatic	417	548	428
Mixed and unspecified	215	336	358
Lime, agricultural, and quicklime[1]	166	231	173
Salt[1] thousand metric tons	244	349	314
Stone, sand and gravel:[1]			
Dimension stone[4] thousand cubic meters	34	35	39
Crushed and broken stone:[5]			
Limestone:			
Agricultural	2,028	1,887	1687
Other	267	278	284
Other thousand cubic meters	[e]10	11	10
Sand:			
Industrial do.	1,461	1,135	1,161
Other do.	666	786	626
MINERAL FUELS AND RELATED MATERIALS			
Coke, gashouse	83	70	[e]70
Peat, agricultural [1]	35	39	40
Petroleum:			
Crude thousand 42-gallon barrels	1,327	1,492	3,285
Refinery products:			
Gasoline do.	12,809	11,863	11,943
Jet fuel do.	28	1	72
Kerosine do.	722	866	775
Distillate fuel oil do.	23,964	[e]25,081	25,588
Residual fuel oil do.	16,515	16,242	14,992
Lubricants do.	30	30	--
Unspecified do.	3,443	3,577	3,839
Refinery fuel and losses do.	2,933	3,615	4,465
Total do.	60,444	61,275	61,674

[e]Estimate. [p]Preliminary. [r]Revised.

[1]Sales.

[2]Includes shipyards production of steel castings.

[3]Excludes steel forgings.

[4]Includes only granite and gneiss; quantity of other dimension stone is not reported, but sales value was $209,878 in 1975, $332,341 in 1976, and $302,838 in 1977.

[5]Partial figures; exclude quartz and quartzite for which quantities are not reported. However, sales value was $203,961 in 1975, $377,833 in 1976, and $356,143 in 1977.

[6]Excludes flint valued at $2,602,938.

Table 2.—Greenland: Production of mineral commodities

(Metric tons)

Commodity[1]	1975	1976	1977[p]
Lead, mine output, metal content	24,300	27,000	28,800
Zinc, mine output, metal content	84,700	81,000	76,600

[p]Preliminary.

[1]In addition to the commodities listed, a variety of crude construction materials (common clay, sand and gravel, and stone) is undoubtedly also produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

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TRADE

In 1977, there was no important change in the trade pattern of Denmark and Greenland. Imports of fossil fuels amounted to about 17% of all imports, while exports of mineral products remained insignificant. The main trading partners were the countries of Europe. Denmark's commodity trade in 1975 and 1976 is shown in tables 3 and 4.

Major items of mineral imports from the United States were iron and steel semimanufactures, nonferrous metals, potash, coal, and petroleum products. Mineral exports to the United States included iron and steel, base metals, and industrial minerals. United States-Denmark and Greenland trade in 1976 is shown in table 5.

Table 3.—Denmark: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Bauxite and concentrate	18,344	21,802	France 6,993; Belgium-Luxembourg 4,917; Netherlands 2,157; Thailand 2,110.
Oxide and hydroxide[1]	r315	64	United States 22; West Germany 15; United Kingdom 12.
Metal including alloys:			
Unwrought, including scrap	r7,562	9,447	West Germany 4,927; Sweden 1,682; Belgium-Luxembourg 1,289.
Semimanufactures	9,195	11,526	Sweden 5,639; West Germany 1,338.
Antimony metal including alloys, all forms	3	6	Norway 5; Venezuela 1.
Chromium, chromite	2	2	NA.
Cobalt metal including alloys, all forms	2	1	All to Sweden.
Copper metal including alloys:			
Scrap	7,841	8,849	West Germany 8,228.
Unwrought	556	821	Sweden 472; West Germany 303.
Semimanufactures	3,574	4,392	United Kingdom 1,858; Sweden 947; Finland 651; West Germany 480.
Iron and steel:			
Ore and concentrate	12,056	8,442	West Germany 4,662; United Kingdom 2,090; Netherlands 930.
Metal:			
Scrap	90,968	115,673	West Germany 52,231; Norway 16,924; United Kingdom 16,349; Sweden 12,844.
Pig iron, including cast iron	538	104	Sweden 71.
Sponge iron, powder, shot	r136	192	Mainly to West Germany.
Ferroalloys	10	17	Mainly to Norway.
Steel, primary forms	r1,297	3,010	Netherlands 896; United Kingdom 894; Norway 673.
Semimanufactures:			
Bars, rods, angles, shapes, sections	101,221	97,202	Sweden 35,152; West Germany 30,257; Norway 11,797.
Universals, plates, sheets	140,161	195,158	Sweden 102,495; West Germany 44,804; Norway 23,630.
Hoop and strip	11,183	16,046	Sweden 15,592.
Rails and accessories	---	3,076	Mexico 2,339.
Wire	7,047	5,862	Sweden 2,285; Finland 1,143; Norway 696.
Tubes, pipes, fittings	r30,524	36,376	Sweden 21,038; West Germany 4,207.
Castings and forgings, rough	19,784	16,589	Sweden 7,237; West Germany 4,549; Norway 2,540.
Total	r309,920	370,309	
Lead:			
Ore and concentrate	245	633	West Germany 610.
Oxide	92	39	West Germany 25; Kuwait 7; Saudi Arabia 7.
Metal including alloys:			
Scrap	402	468	West Germany 372; Sweden 60.
Unwrought	5,293	10,919	U.S.S.R. 2,000; Norway 1,902; Sweden 1,681.
Semimanufactures	279	235	Finland 144; Norway 28.
Magnesium metal including alloys, all forms	r117	113	West Germany 67; Netherlands 16.
Manganese oxide	169	66	Sweden 62.
Molybdenum metal including alloys, all forms	r145	163	West Germany 86; United Kingdom 53.
Platinum-group metals and silver:			
Waste and sweepings, thousand troy ounces	1,343	1,360	United Kingdom 478; West Germany 443; Netherlands 238; Sweden 140.
Metals including alloys:			
Platinum-group, do.	3	(2)	Mainly to Thailand, Sweden, and Finland.
Silver, do.	267	707	Sweden 254; Finland 183; Norway 108; Netherlands 96.

See footnotes at end of table.

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Table 3.—Denmark: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Tin metal including alloys:			
Unwrought	r1,162	78	Australia 37; Sweden 21; West Germany 12.
Semimanufactures	r73	174	Sweden 50; Norway 32; Iraq 27.
Titanium dioxide	157	71	Sweden 45; Sudan 24.
Zinc:			
Oxide	16	9	Saudi Arabia 4; Sweden 3.
Metal including alloys:			
Scrap, including blue powder (dust)	3,465	3,726	West Germany 1,802; Norway 760; Belgium-Luxembourg 520; Pakistan 300.
Unwrought and semimanufactures	175	226	Sweden 68; Pakistan 47; West Germany 27; Belgium-Luxembourg 25.
Other:			
Ash and residue containing nonferrous metals	3,364	3,869	West Germany 1,585; Sweden 644; Belgium-Luxembourg 640; United Kingdom 512; Norway 392.
Oxides, hydroxides, pentoxides of metals, n.e.s.	r27	11	Norway 4; United Kingdom 2.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	r4	6	NA.
Grinding and polishing wheels and stones	r1,891	1,030	Ethiopia 351; Yemen Arab Republic 135; Iran 101.
Asbestos	r112	182	Yugoslavia 48; Sweden 33; West Germany 25; Saudi Arabia 14.
Barite and witherite	24	1,732	United Kingdom 776; Sweden 432; Netherlands 426.
Boron materials, oxide and acid	45	30	Sweden 27.
Cement	r231,593	137,754	Israel 28,204; Iceland 22,978; Faroe Islands 20,071; Dominican Republic 16,294.
Chalk	13,278	14,302	Sweden 6,738; Norway 4,571; Finland 2,182.
Clays and clay products (including all refractory brick):			
Crude	r3,727	2,572	Sweden 1,096; Norway 304; Finland 242.
Products:			
Refractory[3]	33,134	29,862	United Kingdom 6,170; West Germany 5,572; Sweden 2,891; Norway 2,888.
Nonrefractory	63,934	62,556	West Germany 42,788; Sweden 9,612; Norway 5,646.
Cryolite and chiolite	21,082	26,550	NA.
Diamond, gem, not set or strung value, thousands	$96	$140	United Kingdom $68.
Diatomite and other infusorial earth	60,611	63,878	West Germany 40,688; Netherlands 8,401.
Feldspar and fluorspar	75	101	Australia 52; Sweden 49.
Fertilizer materials:			
Crude:			
Phosphatic	--	15	NA.
Other	316	158	Sweden 88; Poland 40; Hungary 28.
Manufactured:			
Nitrogenous	64	21,516	Mainly to West Germany.
Phosphatic	23,924	27,814	East Germany 24,347; West Germany 3,187.
Potassic	1	25	Ghana 15; Norway 6.
Other, including mixed	10,635	8,978	United States 4,995; West Germany 2,992.
Ammonia	r77,746	10,840	United States 5,282; Italy 2,881; Norway 1,317; United Kingdom 1,292.
Graphite, natural	52	23	Sweden 21.
Gypsum and plaster	56	98	Norway 20.
Lime	r24,084	19,881	Norway 13,841; Saudi Arabia 5,068.
Magnesite	8	22	Mainly to Sweden.
Mica, all forms	44	62	Switzerland 15; Finland 14; West Germany 10; Venezuela 10; Yugoslavia 8.
Pigments, mineral, including processed iron oxide	r276	281	Finland 114; Sweden 41; Egypt 30.
Precious and semiprecious stones, except diamond kilograms	73	156	NA.
Salt	81,221	95,917	Sweden 72,485; Norway 14,353.
Sodium and potassium compounds, n.e.s	260	194	Faroe Islands 140; Netherlands 22.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	r48,706	49,693	Mainly to West Germany.
Worked	5,552	3,293	West Germany 2,707.
Dolomite, chiefly refractory grade	r296	55	Faroe Islands 5.
Gravel and crushed rock thousand tons	2,072	1,704	Mainly to West Germany.
Limestone (except dimension)	67,693	49,843	Sweden 26,017; West Germany 15,368; Norway 8,171.
Quartz and quartzite	363	183	Iraq 150; Sweden 18.
Sand, excluding metal bearing	209,822	174,608	Sweden 126,848; Norway 18,425; West Germany 13,482.

See footnotes at end of table.

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Table 3.—Denmark: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Sulfuric acid	4,139	352	Norway 135; Sweden 94; Iceland 33; Faroe Islands 32.
Talc, steatite, soapstone, pyrophyllite	30	72	Iceland 16; Yugoslavia 12.
Other:			
Crude	r681	896	West Germany 764.
Slag, dross, and similar waste, not metal bearing	r27,671	24,935	West Germany 17,266; Norway 4,982; France 2,490.
Oxides and hydroxides of magnesium, strontium, barium	1	107	People's Republic of China 100.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	97	68	Turkey 23; Sweden 12; West Germany 6; Norway 6.
Carbon black and gas carbon	83	39	Sweden 20; United Kingdom 3.
Coal and coke, including briquets	72,098	48,072	Sweden 28,178; Norway 14,249; West Germany 5,881.
Gas, hydrocarbon, liquefied	r10,483	2,710	Sweden 1,904; West Germany 551.
Peat, including peat briquets and litter	2,882	4,015	Netherlands 1,404; Norway 1,312; West Germany 641.
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	r5,687	5,337	Sweden 4,447.
Kerosine, and white spirit do.	263	341	West Germany 136; Sweden 121; Norway 61.
Distillate fuel oil do.	r8,990	10,331	Sweden 6,027; United Kingdom 1,550.
Residual fuel oil do.	r2,710	2,807	Sweden 2,025; Ireland 354.
Lubricants do.	r144	164	Norway 101; Sweden 25.
Mineral jelly and wax do.	4	5	Sweden 2; Finland 1.
Other:			
Liquefied petroleum gas do.	122	31	Sweden 22; West Germany 6.
Nonlubricating oils do.	22	--	
Pitch do.	8	5	Mainly to Sweden.
Bitumen and other residues do.	937	1,029	Sweden 438; Norway 232; West Germany 212; Finland 145.
Bituminous mixtures, n.e.s do.	20	18	Sweden 7; Greenland 4.
Total do.	r18,907	20,068	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	7,539	6,996	NA.

NA Not available. rRevised.
[1]Not including synthetic corundum.
[2]Less than 1/2 unit.
[3]Including those of magnesite, diatomite, and other refractory materials.

Table 4.—Denmark: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite and concentrate	130,418	93,064	Surinam 90,061.
Oxide and hydroxide[1]	1,446	1,542	United Kingdom 800; West Germany 384; United States 278.
Metal including alloys:			
Scrap	1,835	2,260	Norway 728; West Germany 663; Sweden 536; Belgium-Luxembourg 307.
Unwrought	r5,035	10,916	Norway 8,341; United Kingdom 1,136.
Semimanufactures	r39,609	56,828	West Germany 11,767; Sweden 9,290; Norway 8,662; Belgium-Luxembourg 6,733.
Antimony metal including alloys, all forms	11	12	People's Republic of China 7; Germany 3; Sweden 2.
Cadmium metal including alloys, all forms	3	6	All from Norway.
Chromium:			
Chromite	842	399	Republic of South Africa 324; Finland 65.
Oxide and hydroxide	472	551	West Germany 341; Italy 80; U.S.S.R. 80.
Cobalt:			
Oxide and hydroxide	12	16	Canada 8; Belgium-Luxembourg 5; United Kingdom 3.
Metal including alloys, all forms	13	20	Belgium-Luxembourg 15; United Kingdom 3.

See footnotes at end of table.

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Table 4.—Denmark: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Copper metal including alloys:			
Scrap	r1,564	1,473	Sudan 450; West Germany 446; United Kingdom 164.
Unwrought	r4,458	5,849	Belgium-Luxembourg 4,713; United Kingdom 582; Sweden 520.
Semimanufactures and master alloys	r24,441	32,918	Belgium-Luxembourg 9,302; Sweden 9,120; West Germany 5,439; United Kingdom 3,532.
Iron and steel:			
Ore and concentrate	r727	746	All from Sweden.
Roasted pyrite	30,400	39,990	All from Norway.
Metal:			
Scrap	r3,191	7,072	West Germany 2,864; Sweden 2,219; Norway 1,309.
Pig iron, including cast iron[2]	r80,618	38,864	West Germany 9,982; U.S.S.R. 8,770; United Kingdom 7,037; Finland 4,467.
Ferroalloys	16,892	19,116	Norway 14,609; United Kingdom 1,803.
Steel, primary forms	72,091	46,439	Norway 13,129; West Germany 7,477; Japan 6,489; Hungary 5,668; Bulgaria 5,044.
Semimanufactures:			
Bars, rods, angles, shapes, sections[3]	314,811	428,860	West Germany 122,393; Belgium-Luxembourg 65,039; Sweden 63,854; France 61,746.
Universals, plates, sheets	640,755	756,522	West Germany 216,714; Sweden 107,332; France 89,010; Belgium-Luxembourg 73,583.
Hoop and strip	45,933	66,386	West Germany 28,113; Sweden 10,316; Netherlands 9,447; Belgium-Luxembourg 6,315.
Rails and accessories	r16,056	12,896	West Germany 8,823; France 2,922.
Wire	18,175	26,403	West Germany 10,135; Belgium-Luxembourg 9,016; Sweden 4,590.
Tubes, pipes, fittings	r161,055	205,789	West Germany 58,369; United Kingdom 32,785; France 26,194; U.S.S.R. 21,359.
Castings and forgings, rough	1,002	1,239	West Germany 399; Switzerland 247; United Kingdom 245; Sweden 149.
Total	r1,197,787	1,498,095	
Lead:			
Oxide	895	802	West Germany 300; East Germany 162; France 139; United Kingdom 113; Mexico 80.
Metal including alloys:			
Scrap	6,013	12,545	West Germany 4,229; Norway 3,094; United Kingdom 1,553.
Unwrought	7,621	7,351	Sweden 3,898; Canada 1,614.
Semimanufactures	r1,426	1,864	West Germany 1,762.
Magnesium metal including alloys, all forms	r131	191	Norway 123; France 42.
Manganese:			
Ore and concentrate	2,772	2,520	Gabon 721; Greece 679; Ghana 525; Netherlands 375.
Oxide	r1,460	2,448	Belgium-Luxembourg 1,347; Greece 360; People's Republic of China 234.
Mercury 76-pound flasks	406	580	NA.
Molybdenum metal including alloys, all forms	3	5	West Germany 3; Austria 2.
Nickel:			
Matte	3	(4)	NA.
Metal including alloys:			
Unwrought, including scrap	r261	212	Canada 63; United Kingdom 57; United States 49; Finland 32.
Semimanufactures	r252	241	West Germany 98; United Kingdom 47; Sweden 23.
Platinum-group silver and metals including alloys, all forms:			
Platinum-group thousand troy ounces	17	21	Switzerland 8; Netherlands 4; West Germany 3.
Silver do	r1,974	3,191	West Germany 1,101; United Kingdom 769; Switzerland 413; France 345.
Tin:			
Oxide	2	4	West Germany 2; United Kingdom 2.
Metal including alloys:			
Scrap	149	239	Switzerland 69; West Germany 39; Netherlands 35; Austria 31; Singapore 24.
Unwrought	302	421	People's Republic of China 170; Malaysia 81; United Kingdom 41.
Semimanufactures	r107	127	West Germany 71; United Kingdom 19; Norway 13.
Titanium oxide	5,306	5,956	Norway 1,743; Finland 999; United Kingdom 875; Netherlands 836; France 573.

See footnotes at end of table.

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Table 4.—Denmark: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Tungsten metal including alloys, all forms	r8	10	Sweden 5; West Germany 4; Austria 1.
Zinc:			
Oxide	r2,198	2,466	West Germany 874; Poland 392; United Kingdom 291; Norway 265.
Metal including alloys:			
Blue powder, including scrap	1,013	921	Belgium-Luxembourg 388; Norway 179.
Unwrought	r12,634	11,870	Norway 3,660; Netherlands 2,560; Finland 2,397; United Kingdom 1,326.
Semimanufactures	4,216	4,258	France 3,025; West Germany 831.
Other:			
Ores and concentrates of base metals, n.e.s	r540	331	Finland 165; Sweden 119; Republic of South Africa 45.
Ash and residue containing nonferrous metals	8,197	11,629	United States 3,115; Sweden 2,324; United Kingdom 1,339; Netherlands 1,132.
Metals including alloys, all forms:			
Metalloids	309	638	France 400; Norway 150; Sweden 82.
Alkali, alkaline-earth, rare-earth metals	206	155	Mainly from West Germany.
Pyrophoric alloys	4	7	United Kingdom 5; Austria 1; West Germany 1.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	r7,444	9,041	West Germany 7,875.
Dust and powder of precious and semiprecious stones kilograms	23	37	West Germany 27; Switzerland 9.
Grinding and polishing wheels and stones	r1,065	1,151	West Germany 376; Austria 282; Sweden 251.
Asbestos	24,388	30,625	Canada 15,843; Cyprus 5,086; West Germany 4,091; Republic of South Africa 3,761.
Barite and witherite	5,325	11,264	Ireland 4,815; United Kingdom 4,098; Morocco 1,000.
Boron materials:			
Crude natural borates	r50,114	49,565	West Germany 41,408; Sweden 4,980.
Oxide and acid	270	273	France 158; United States 47; West Germany 26.
Cement	5,187	10,952	West Germany 4,592; Sweden 4,164; United Kingdom 1,722.
Chalk	4,705	6,622	Sweden 3,332; West Germany 2,503; France 689.
Clays and clay products (including all refractory brick):			
Crude: kaolin and other	r34,980	31,382	United Kingdom 18,855; West Germany 5,445.
Products:			
Refractory (including nonclay brick)	r39,547	36,606	West Germany 16,424; Austria 9,244; Sweden 5,142; United Kingdom 4,118.
Nonrefractory	64,145	100,071	West Germany 50,644; Italy 26,048.
Cryolite and chiolite	57,600	47,565	All from Greenland.
Diamond:			
Gem, not set or strung carats	r13,995	r15,000	Belgium-Luxembourg 1,000; West Germany 1,000.
Industrial kilograms	r43,183	19	West Germany 5; Switzerland 2; Belgium-Luxembourg 1; Hong Kong.
Diatomite and other infusorial earth	3,869	4,059	United States 1,904; Ireland 1,192; France 410; Spain 398.
Feldspar, leucite, nepheline syenite	9,537	10,426	Norway 9,645.
Fertilizer materials:			
Crude:			
Nitrogenous	4,659	1,346	All from Chile.
Phosphatic	257,668	260,718	Morocco 187,368; U.S.S.R. 72,963.
Potassic	850	1,050	All from West Germany.
Manufactured:			
Nitrogenous	r122,761	139,138	Norway 72,687; Netherlands 20,660; Spain 11,298.
Phosphatic:			
Thomas (basic) slag	100	--	
Other	5,343	34,996	United States 28,980; West Germany 4,123.
Potassic	r207,176	204,651	West Germany 120,962; East Germany 55,619.
Other, including mixed	r607,528	412,960	Norway 312,880; West Germany 44,698.
Ammonia	300,004	243,751	West Germany 104,669; East Germany 44,262; Venezuela 30,732.
Fluorspar	r2,884	3,969	France 2,675; United Kingdom 1,111.
Graphite, natural	441	493	West Germany 260; United Kingdom 120; Sweden 99.
Gypsum and plaster	276,541	291,921	Spain 154,984; Poland 73,486; U.S.S.R. 42,064.
Lime	r2,693	2,138	West Germany 1,446; Poland 615.
Magnesite	r10,865	9,810	Czechoslovakia 3,215; Austria 2,313; Spain 2,240; People's Republic of China 1,342.

See footnotes at end of table.

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Table 4.—Denmark: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Mica:			
Crude, including splittings and waste	r247	274	United Kingdom 121; Norway 57; India 34; Canada 26.
Worked, including agglomerated splittings	r75	86	Belgium-Luxembourg 28; West Germany 28; France 15; Spain 10.
Pigments, mineral:			
Natural, crude	356	497	Cyprus 247; West Germany 93.
Iron oxides, processed	r3,439	5,297	West Germany 4,527; Spain 495.
Precious and semiprecious stones, except diamond kilograms	3,304	9,961	Brazil 7,096; West Germany 1,070.
Pyrite	36	--	
Salt	r122,234	205,686	West Germany 86,271; U.S.S.R. 33,290; Italy 30,145; Poland 27,774.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	r3,219	4,472	Sweden 3,125; Italy 1,202.
Slate	9,231	10,753	Norway 5,118; West Germany 2,444; Sweden 1,820.
Other (granite, gneiss, etc.)	17,163	152,974	Sweden 136,423; Norway 16,335.
Worked, all types	r42,975	50,610	Portugal 15,768; West Germany 12,275; Sweden 11,884; Poland 5,265.
Dolomite, chiefly refractory grade	22,169	29,265	Norway 20,939; United Kingdom 2,990.
Gravel and crushed rock	588,312	676,928	Sweden 620,472.
Limestone (except dimension)	182,691	198,286	Sweden 109,787; United Kingdom 44,491; Norway 30,170.
Quartz and quartzite	r6,638	7,985	Sweden 3,529; West Germany 2,385; Norway 1,858.
Sand, excluding metal bearing	148,864	170,108	Belgium-Luxembourg 109,125; Norway 48,702.
Sulfur:			
Elemental, all forms	r69,675	62,651	West Germany 61,152.
Sulfur dioxide and sulfuric acid	r2,438	4,669	West Germany 3,980.
Talc, steatite, soapstone, pyrophyllite	9,365	11,525	Norway 5,737; West Germany 3,338.
Other:			
Crude	r50,115	50,341	West Germany 41,408; Sweden 4,955.
Slag, dross, and similar waste, not metal bearing	5,823	7,877	West Germany 4,466; United Kingdom 2,362.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	707	619	United States 361; West Germany 192.
Carbon black	r3,064	3,995	West Germany 1,348; Sweden 1,043; United Kingdom 651; United States 357.
Coal and coke, including briquets thousand tons	r4,264	4,317	Poland 3,168; U.S.S.R. 640.
Gas, hydrocarbon, liquefied do.	91	116	United Kingdom 37; West Germany 29; Netherlands 15; Sweden 13.
Peat, including peat briquets and litter	r14,925	18,534	Sweden 12,349; U.S.S.R. 2,987.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	r58,019	55,793	Iran 17,003; Saudi Arabia 8,409; U.S.S.R. 6,905; Nigeria 5,468.
Refinery products:			
Gasoline do.	r9,835	10,294	Netherlands 2,692; United Kingdom 2,027; Belgium-Luxembourg 1,827; Sweden 1,449.
Kerosine and jet fuel do.	r5,840	8,019	Netherlands 3,175; Belgium-Luxembourg 1,376; United Kingdom 1,132.
Distillate fuel oil do.	28,236	32,279	United Kingdom 10,795; Belgium-Luxembourg 4,665; U.S.S.R. 3,994; Netherlands 3,880.
Residual fuel oil do.	32,348	27,279	Netherlands 7,592; Sweden 6,637; Norway 2,535.
Lubricants do.	r600	757	United Kingdom 232; West Germany 190; Netherlands 178; Sweden 84.
Mineral jelly and wax do.	r104	124	West Germany 83.
Other:			
Nonlubricating oils, n.e.s. do.	89	--	
Petroleum coke do.	2	2	Mainly from West Germany.
Bitumen and other residues do.	1,173	1,238	Netherlands 639; West Germany 431; Sweden 119.
Bituminous mixtures, n.e.s do.	11	10	West Germany 6; United Kingdom 2.
Total do.	r78,238	80,002	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	13,378	24,709	Sweden 8,064; Norway 4,365; West Germany 3,147; United States-Puerto Rico 2,522.

rRevised. NA Not available.
[1]Not including synthetic corundum.
[2]Includes spiegeleisen, gut, sponge, powder, and shot of iron and steel.
[3]Including wire rod.
[4]Less than 1/2 unit.

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Table 5.—Denmark and Greenland: Mineral trade with the United States,1976[1]

Commodity	Exports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
METALS				
Aluminum metal including alloys	1	$8	4,552	$6,717
Copper metal including alloys	2	11	1,696	2,611
Iron and steel:				
Ore and concentrate	75	3	--	--
Metal:				
Scrap	--	--	36	30
Ferroalloys	--	--	193	69
Steel, primary forms	5,628	1,266	--	--
Semimanufactures:				
Bars and angles	10	6	29	30
Plates and sheets	--	--	5,471	1,783
Hoop and strip	--	--	67	59
Wire	63	25	39	71
Tubes and pipes	72	247	576	671
Castings and forgings	(2)	(2)	(2)	2
Lead metal including alloys	498	683	31	27
Nickel metal including alloys	--	--	3	29
Platinum and silver ores	NA	331	--	--
Radioactive and associated materials	NA	5	1	391
Tin metal including alloys	498	134	--	--
Zinc metal including alloys	--	--	28	35
Other nonferrous metals:				
Ores and concentrates, n.e.s.	37	28	2,622	2,245
Base metals including alloys, n.e.s.	20	460	6	58
NONMETALS				
Abrasives, natural, including diamond	--	--	1,902	247
Cement	222	85	--	--
Diamond and precious stones	NA	40	1	67
Fertilizer materials: Potash	--	--	8,015	428
Quartz, mica, feldspar, etc	1,825	802	--	--
Salt, sodium chloride	9	11	--	--
Stone, sand and gravel:				
Dimension stone	2	1	--	--
Crushed and broken stone, sand and gravel	--	--	378	49
Other, crude	88	2	--	--
MINERAL FUELS AND RELATED MATERIALS				
Coal, all types	--	--	31,218	840
Gas, natural and manufactured	--	--	101	3
Petroleum refinery products:				
Residual fuel oil	33	2	--	--
Lubricants	1	1	769	668
Petroleum jelly and mineral waxes	--	--	368	181
Petroleum coke, asphalt, etc	--	--	1,078	194
Total	XX	4,151	XX	17,505

NA Not available. XX Not applicable.
[1]Data may differ from those reported elsewhere in this chapter owing to a difference in source.
[2]Less than 1/2 unit.

Source: U.S. Department of Commerce, Bureau of the Census.

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COMMODITY REVIEW

DENMARK

Metals.-*Iron and Steel.*—Production of iron and steel was based mainly on scrap, supplemented with small quantities of domestic iron ore and roasted pyrite. Det Danske Stålvalsevaerk A/S (DDS), with plants located at Frederiksvaerk and Helsingør on Sjaelland Island north of Copenhagen and a virtually all-electric steelmaker, remained the country's main iron and steel producer. The company's principal products included heavy plates and merchant bars.

Nonmetals.—*Cement.*-In 1977, A/S Alborg-Portland-Cement Fabrikk, owned by F. L. Smidth & Co. A/S, operated the country's three cement plants with a total capacity of 2.67 million tons per year, including a 2.2-million-ton-per-year plant and a 185,000-ton-per-year plant (temporarily out of production) at Rördal near Ålborg, and a 285,000-ton-per-year plant at Lindholm near Nörresundby. Another company plant at Dania near Mariager continued to be used to calcine bauxite imported from Guyana.

Diatomite.—Denmark was after the United States and the U.S.S.R., the world's third largest diatomite producer in 1977, with a production of 255,000 tons. Major Danish producers were Skarrehage Molervaerk A/S, Branden Molervaerk A/S, Danske Moler Industri A/S, and Molervaerk Ludolph Struve A/S.[4]

Moler, the local name for diatomite, is a tertiary clayey diatomaceous earth found in Denmark and is mined mainly on Fur and Mors Islands.

Fertilizer Materials.—In 1977, Superfos A/S, the country's largest fertilizer maker, continued construction of a 550,000-ton-per-year ammonia plant at Brunsbüttel in Schleswig-Holstein State, Federal Republic of Germany. Veba-Chemie AG, of the Federal Republic of Germany, was the Superfos associate in this project. There was no ammonia plant in Denmark itself.

Mineral Fuels.—In 1977, Denmark remained almost completely dependent on imported fuels, with only nominal crude oil and hydroelectric power production. Use of alternate sources of energy such as nuclear power and natural gas remained under discussion.

Table 6 shows the supply and apparent consumption of fuels and power in Denmark and Greenland in 1976 and 1977.

Table 6.—Denmark and Greenland: Supply and apparent consumption of fuels and power for 1976 and 1977

(Million tons of standard coal equivalent[1])

	Total energy	Coal and coke	Petroleum and refinery products[2]	Hydroelectric power[3]
1976:				
Production[4]	0.3	--	0.3	--
Imports	32.8	4.4	28.1	0.3
Exports	4.1	--	3.9	.2
Apparent consumption	29.0	4.4	24.5	.1
1977:[p]				
Production[4]	.8	--	.8	([5])
Imports	35.1	5.7	29.1	.3
Exports	3.4	--	3.2	.2
Apparent consumption	32.5	5.7	26.7	.1

[p]Preliminary.
[1]1 ton standard coal equivalent=7,000,000 kilocalories.
[2]Includes some liquid natural gas imports.
[3]Includes foreign trade of all electricity.
[4]Includes only primary energy.
[5]Less than 1/2 unit.

Source: Danmarks Statistisk (Copenhagen). Monthly Bulletin of Foreign Trade December 1977.

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Petroleum and Natural Gas.—Dan, Denmark's only operational oilfield in 1977, was located 200 kilometers west of Esbjerg in 41 meters of water. It had three steel drilling platforms from which the production was tanker-loaded at a rate of 700,000 tons per year. Crude oil production was to decrease in 1978 when Denmark's three production wells are to be redrilled.

Estimated recoverable oil reserves in the Danish sector of the North Sea were 18 million tons at the end of 1977.[5]

The Danish Underground Consortium (DUC), the only operator in the Danish sector of the North Sea, undertook exploration in the vicinity of the Dan Field and made two oil discoveries (Ruth and Adda) and one gas discovery (Vagn). DUC filed an application to develop the Gorm Field, 27 kilometers northwest of Dan, but was refused because production would have involved flaring of the gas produced.

In 1977, Denmark's petroleum refining capacity remained at 11.6 million tons. Major companies involved in refining were Gulf Oil Refining A/S, Dansk Esso A/S, and A/S Dansk Shell, with refineries at Stigsnaes, Kalundborg, and Fredericia, respectively.

GREENLAND

In 1977, Greenland produced lead and zinc concentrates and shipped some crude cryolite from existing stocks.

Metals.—*Iron Ore.*—Preparations continued to mine iron ore at Isua, located on Godthaab Fjord. The project is a joint venture involving Kryolitselskabet Øresund A/S and Marcona Corp. of New York.

Lead and Zinc.—In 1977, for the fourth consecutive year, Greenex A/S operated the Black Angel mine at Marmorilik on the western coast of Greenland under a concession from Denmark's Ministry for Greenland. The production of 553,000 tons of ore contained 15.1% zinc and 6.1% lead. Concentrates were sold to various Western European smelters.[6]

Exploration by surface and underground drilling was successful in maintaining ore reserves equivalent to 6 years' production, or 3.6 million tons of ore containing 4.0% lead, 12.4% zinc, and 1 troy ounce per ton of silver. Mineralization found on nearby Uvkussigsat Peninsula in 1976 was mapped in 1977.

Nonmetals.—*Cryolite.*—Shipping of cryolite ore from stock at the depleted mine at Ivigtut continued at a reduced rate and with lower grade. Shipments were processed at the concentrating plant in Denmark.

Mineral Fuels.—Petroleum.—The second season of offshore exploratory drilling off the west coast of Greenland was closed, resulting in four dry wells. Denmark's Ministry for Greenland received no applications for offshore drilling near Greenland for 1978. In 1977, unsuccessful exploration was focused in areas offshore Holsteinsborg and Sukkertoppen.

Uranium.—In 1977, uranium reserves in the Kvanefjeld Mountains near Narssaq in southern Greenland almost tripled as a result of further drilling carried out during the summer months. Known reserves of uranium are now put at 15,700 tons[7] and estimated reserves at another 10,000 tons. The average grade of the ore is 300 grams of uranium per ton. One-third of the drilling cost of $1.5 million was provided by the European Economic Community in exchange for a share in future production.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Danish kroner to U.S. dollars (DKr) at the rate of DKr6.25=US$1.00.

[3]U.S. Department of Commerce. Foreign Economic Trends and Their Implications for the U.S., Denmark. March 1978, p. 2.

[4]Industrial Minerals. No. 123, December 1977, p. 45.

[5]Petroleum Economist. Apr. 1, 1978, p. 139.

[6]Greenex A/S. 1977 Annual Report. P. 4.

[7]Mining Magazine (London). V. 138, No. 1, January 1978, p. 57.

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The Mineral Industry of Egypt

By Candice Stevens[1]

Egypt's mineral industry contributed approximately 17% to the 1977 gross national product (GNP), estimated at $17 billion.[2] Increased petroleum revenues, in addition to greater earnings from augmented production of phosphate rock, steel, and aluminum, were expected to make the mineral sector a more significant contributor to the nation's economy within the next few years. The 5-year plan (1976-80) forecast that the value of the industrial and mineral sectors would grow 12% by 1980. Approximately $870 million was allocated to the development of this sector, with the major portion devoted to the Helwân iron and steel complex, the Nag' Hammadi aluminum plant, the Abu Tartûr phosphate deposits, and the fertilizer and cement industries.

At yearend, Egypt's medium and long term debt was approximately $12 billion. Egypt continued as the largest recipient of U.S. aid, which totaled $900 million in fiscal year 1977. A loan of $1.5 billion was received from the Gulf Organization for Development in Egypt (GODE), established in 1976 by Saudi Arabia, Kuwait, the United Arab Emirates, and Qatar to provide project support and assist in remedying the balance-of-payments deficit. The Consultative Group for the Arab Republic of Egypt, composed of 15 countries and agencies including the United States, Japan, Western European countries, the International Bank for Reconstruction and Development (IBRD), and the International Monetary Fund (IMF), held its first meeting in May 1977. The Consultative Group, which was formed to coordinate Egyptian aid programs, sought to identify specific projects in the 5-year plan for which loans could be made.

In 1977, further revisions were enacted in Egypt's Investment Law No. 43 to attract greater foreign participation in development. New provisions minimized restrictions on holding and using foreign exchange, altered the fixed exchange rate system, and granted income tax exemptions on Arab and foreign investments. Also under consideration were revisions to the mining code to encourage foreign investment under partnership agreements with the Government. In 1976, private Egyptian companies for the first time were given leases for mineral exploration and development of small mineral deposits.

The Egyptian Geological Survey Organization was responsible for developing proposals for joint venture mineral exploration and/or development projects. In 1977, the U.S. Geological Survey continued its general mineral resource identification program. Egypt was to initiate a pilot study of the Wadi Natrum area northwest of Cairo, where a large freshwater reservoir had been identified beneath the Western Desert.

Work continued on deepening and widening the Suez Canal, which was reopened in June 1975 following an 8-year closure brought about by the 1967 Arab-Israeli war. The expansion program, undertaken by an international group of contractors at a cost of $1 billion, was to enable ships up to 150,000 tons laden and 300,000 tons in ballast to transit the Canal. In 1977, an average of 60 ships per day used the Canal, 40% of which were oil tankers. The Suez Canal was expected to earn $1 billion in transit fees by 1980.

A 20-year port development plan was proposed to ease congestion at Egypt's overloaded terminals and to accommodate increased mineral exports. The ports at Suez,

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Ismailia, and Port Said were to undergo renovation and expansion. New industrial and mineral ports were to be constructed at Dekhela, Port Safâga, and Hamrawein.

Table 1.—Egypt: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]		1975	1976	1977[p]
METALS				
Aluminum metal		2,000	59,000	89,182
Chromite		240	[e]240	--
Iron and steel:				
Ore and concentrate	thousand tons	1,087	1,243	1,387
Metal:				
Pig iron	do	420	569	74
Ferroalloys (ferrosilicon)	do	5	[e]5	5
Steel, crude	do	348	47	263
Semimanufactures	do	436	706	621
Manganese ore and concentrate		3,581	4,256	3,833
NONMETALS				
Asbestos		[2]479	[2]1,096	478
Barite		749	288	746
Cement, hydraulic	thousand tons	3,584	3,362	3,257
Clays:				
Bentonite		[e]4,000	4,233	3,811
Fire clay		253,621	170,052	143,648
Kaolin		33,364	28,267	49,000
Diatomite		1,600	327	373
Feldspar, crude		850	2,128	2,633
Fertilizer materials:				
Crude, phosphate rock	thousand tons	536	394	472
Manufactured:				
Nitrogenous (N content)	do	125	NA	103
Phosphatic:				
Thomas slag	do	32	523	NA
Superphosphate	do	520		521
Fluorspar		2,365	[e]2,400	1,404
Gypsum and anhydrite, crude	thousand tons	600	467	509
Mica		7	[e]10	86
Pumice		250	[e]300	[e]300
Salt, marine	thousand tons	621	480	597
Sodium sulfate, natural		4,039	[e]4,000	[e]5,000
Stone, sand and gravel:				
Basalt	thousand cubic meters	[3]311	243	213
Dolomite	thousand tons	100	120	92
Granite:				
Broken	do	20	NA	NA
Dimension	cubic meters	500	NA	NA
Gravel	thousand cubic meters	1,300	NA	NA
Limestone and other calcareous stone	do	5,300	5,400	NA
Marble:				
Blocks (including alabaster)	cubic meters	8,000	NA	11,000
Broken and gravel		5,500	NA	NA
Quartz		6,470	NA	NA
Sand, including glass sand	thousand cubic meters	3,430	NA	NA
Sandstone	do	110	NA	NA
Other	do	120	NA	NA
Sulfur:				
Elemental, byproduct		4,000	5,000	[e]5,000
Sulfuric acid		37,255	31,000	NA
Talc, soapstone, steatite, pyrophyllite		4,407	5,636	6,993
MINERAL FUELS AND RELATED MATERIALS				
Coke:				
Oven and beehive	thousand tons	645	[e]650	694
Gashouse and other low-temperature	do	[e]30	29	[e]30
Total	do	675	679	724
Gas, natural:				
Gross[e]	million cubic feet	50,600	72,000	91,000
Marketed	do	1,606	13,432	[e]14,200
Petroleum:				
Crude	thousand 42-gallon barrels	84,348	120,180	150,925
Refinery products:				
Gasoline and naphtha	do	11,314	12,521	6,936
Kerosine and jet fuel	do	10,012	11,196	11,671
Distillate fuel oil	do	11,988	12,809	14,629
Residual fuel oil	do	28,425	33,673	32,265
Lubricants	do	371	--	336

See footnotes at end of table.

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Table 1.—Egypt: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]		1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS —Continued				
Petroleum —Continued				
Refinery products —Continued				
Other:				
Liquefied petroleum gas	thousand 42-gallon barrels	580	--	846
Asphalt	do	715	818	--
Unspecified	do	--	--	6,239
Refinery fuel and losses	do	1,805	4,279	3,976
Total	do	65,210	75,296	76,898

[e]Estimate. [p]Preliminary. NA Not available.

[1]Egypt also produces some sodium carbonate, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2]Previously reported incorrectly as including vermiculite.

[3]Quantity reported is valued at $2,047,951; excludes quantity valued at $305,025.

PRODUCTION AND TRADE

Production of petroleum, Egypt's major mineral commodity, increased 26% from 120 million barrels in 1976 to 151 million barrels in 1977. Production of refined petroleum products and natural gas also evidenced increases in 1977. Iron ore output rose as the Bahariya Oasis deposits were brought into full production. Production of steel at the Helwân iron and steel complex and of aluminum at the Nag' Hammadi aluminum complex both increased in 1977 as technical difficulties at the two plants were remedied. Although startup of new phosphate mines was delayed until 1978, phosphate rock production registered a 20% increase. Production of two other key mineral products, cement and fertilizer, was expected to greatly increase over the next few years as new plants were brought on-stream. Egypt also produced smaller quantities of manganese, barite, gypsum, talc, and salt. Minerals produced in Egypt are shown in table 1.

Egypt's overall balance-of-trade deficit rose to approximately $3.5 billion in 1977, as increased petroleum exports were unable to offset rising imports of both foodstuffs and capital goods. Egypt became a consistent net exporter of oil in 1974 and sought to earn more than $1 billion through oil exports by 1980. In 1977, petroleum exports were valued at $729 million and imports at $180 million, giving Egypt a $549 million surplus on its oil account. In addition to petroleum, Egypt's other important mineral exports were phosphate rock and aluminum. Both the Suez Canal and the Suez-Mediterranean (SUMED) pipeline assumed increased importance as foreign exchange earners in 1977. Egypt's trade in mineral commodities is shown in tables 2 and 3.

Table 2.—Egypt: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum metal including alloys:		
Unwrought	--	2,122
Semimanufactures	--	21,902
Copper metal, unwrought	--	100
Iron and steel metal:		
Pig iron, cast iron, spiegeleisen	97,420	38,584
Ferroalloys	--	1,000
Semimanufactures:		
Bars, rods, angles, shapes, sections	--	177
Plates and sheets	41,497	19,687
Tubes and pipes	--	1,700

See footnotes at end of table.

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Table 2.—Egypt: Exports and reexports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS			
Cement		86,196	24,609
Fertilizer materials, phosphatic:			
Crude		104,670	119,383
Manufactured		26,935	31,250
Graphite		--	150
Gypsum		r650	9,523
Lime		--	7,056
Salt, common		10,151	7,006
MINERAL FUELS AND RELATED MATERIALS			
Carbon black		250	538
Petroleum:			
Crude	thousand 42-gallon barrels	r11,406	32,836
Refinery products:			
Distillate fuel oil	do	1,816	3,279
Asphalt and bitumen	do	--	31

rRevised.

Source: Central Agency for Public Mobilization and Statistics. Monthly Bulletin of Foreign Trade. June 1977, p. 658.

Table 3.—Egypt: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS			
Aluminum:			
Alumina		--	53
Metal including alloys:			
Unwrought[1]		7,705	1,533
Semimanufactures		1,923	1,840
Copper metal including alloys:			
Unwrought[2]		3,499	559
Semimanufactures		125	2,276
Gold metal, unworked	troy ounces	--	145
Iron and steel:			
Roasted iron pyrites		7,570	20,530
Metal:			
Scrap		80,855	69,454
Pig iron, including cast iron		57,341	36,571
Ferroalloys		7,537	1,078
Steel, primary forms		68,068	20,811
Semimanufactures:			
Bars, rods, angles, shapes, sections		192,741	303,520
Universals, plates, sheets		75,260	56,670
Hoop and strip		38,577	16,377
Rails and accessories		9,076	29,151
Wire		15,275	16,615
Tubes, pipes, fittings		101,518	71,443
Ingots and semimanufactures, high-carbon alloy steel		3,943	8,160
Lead:			
Oxide		--	1,465
Metal including alloys:			
Scrap		--	1,005
Unwrought		15,242	5,540
Manganese oxide		--	1,906
Mercury	76-pound flasks	--	377
Silver metal	troy ounces	--	52,607
Tin metal including alloys:			
Unwrought		353	854
Semimanufactures		--	128
Titanium oxide		--	1,127
Tungsten metal, unwrought		--	4
Zinc:			
Oxide		--	340
Metal including alloys:			
Unwrought		8,363	1,454
Semimanufactures		--	603

See footnotes at end of table.

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Table 3.—Egypt: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS			
Abrasives:			
Crude, natural corundum		--	143
Grinding and polishing wheels and stones		--	269
Asbestos		5,477	13,322
Cement		103,412	602,574
Clays and clay products:			
Crude		15,543	22,314
Products, refractory		11,140	18,124
Cryolite and chiolite		NA	4,229
Diatomite and other infusorial earth		--	431
Feldspar and fluorspar		--	192
Fertilizer materials, crude and manufactured		423,853	433,297
Graphite		--	1,456
Pigments, mineral: Processed iron oxides		NA	1,307
Pyrites, unroasted		62,857	20,179
Salt, common		--	320
Sodium and potassium compounds:			
Caustic soda		NA	58,297
Caustic potash		NA	454
Stone, marble		NA	4,740
Sulfur		38,130	75,954
Talc		--	298
MINERAL FUELS AND RELATED MATERIALS			
Carbon black		NA	3,156
Coal		1,514,015	978,513
Coke		236,671	51,763
Peat		NA	2,006
Petroleum:			
Crude	thousand 42-gallon barrels	17,024	4,702
Refinery products:			
Gasoline	do	7	25
Kerosine	do	(3)	415
Lubricants	do	166	390
Other:			
Liquefied petroleum gas	do	1,396	1,843
Paraffin wax	do	22	35
Unspecified	do	NA	743

NA Not available.
[1]May include waste and scrap.
[2]May include copper matte, waste, and scrap.
[3]Less than 1/2 unit.

Source: Central Agency for Public Mobilization and Statistics. Monthly Bulletin of Foreign Trade. June 1977, p. 658.

COMMODITY REVIEW

METALS

Aluminum.—Production of aluminum ingot at the Nag' Hammadi complex increased from 55,000 tons in 1976 to approximately 89,000 tons in 1977. The plant, situated 200 kilometers west of Port Safâga on the Red Sea, began production at yearend 1975. Expansion to an annual capacity of 160,000 tons was scheduled for 1980. Alumina was imported from Australia in 1977. Aluminum ingot was exported to Western European countries and Japan.

Arab Aluminum Co., a joint venture of Egyptian, Kuwaiti, and U.S. investors, began production at its plant in Ismailia in October 1977. The aluminum-fabricating facility was to produce a variety of industrial and consumer products for domestic use and export.

Copper.—Copper-nickel deposits in the Eastern Desert were under investigation by the Egyptian Geological Survey Organization. Reserves at Um-Simiuki were previously estimated at 70,000 to 80,000 tons of ore containing 3% to 4% copper.

Iron and Steel.—Production of iron ore, which came primarily from the Bahariya Oasis, totaled 1.4 million tons in 1977. Smaller iron ore deposits at Aswan were being phased out as the Bahariya Oasis deposits, located 300 kilometers southwest of Helwân, were brought into full operation. Production capacity at the Bahariya Oasis was 1.5 million tons per year, to be in-

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creased to 3.5 million tons per year by the early 1980's. Reserves were estimated at 200 million tons of ore containing 54% iron and 3% silica. A 350-kilometer railroad was completed during the year linking the Bahariya Oasis deposits with Helwân.

Iron ore production was used by the Helwân iron and steel complex, which produced approximately 880,000 tons of crude steel and steel products in 1977. Operational difficulties, including equipment breakdowns and a lack of spare parts, a shortage of trained technicians, and irregularities in the supply of coking coal, prevented the plant from reaching its targeted output of 1.5 million tons of steel. Steps were being taken to construct onsite workshops for maintenance and supply of spare parts, to establish a metallurgical institute for training engineers, and to double the plant's production of coke. In addition, the Government contracted a Japanese consortium to prepare a feasibility study for overall modernization of the Helwân complex, which began production in 1958.

A direct-reduction steel plant was to be built at Dekhela by a joint venture including the General Organization for Industrialization (50%), C. Itoh & Co., Ltd. (Japan) (25%), Korf Stahl A.G. (Federal Republic of Germany) (15%), and Cia. Vale do Rio Doce (Brazil) (10%). The $380 million plant was to use iron ore pellets imported from Brazil and natural gas from the Abu Qir field. Production, to begin in 1981, was to total 1.6 million tons of steel per year.

Manganese.—Egypt produced approximately 3,800 tons of manganese from the Wadi Meialik deposits in the Eastern Desert. This was the only manganese-producing area of Egypt, which had previously mined 200,000 tons of manganese per year at Umma Bogma on the Sinai Peninsula. Reserves at Umma Bogma, which came under Israeli control in 1967, were estimated at 2 million tons of 21% manganese ore.

Uranium.—Feasibility studies were being conducted on the production of uranium from the Abu Tartûr phosphate deposits and the uraniferous black sands along the Mediterranean coast and the Nile Delta. The phosphate deposits at Abu Tartûr were estimated to contain 100,000 tons of uranium or 100 grams of uranium per ton of ore. Monazite in the black sands was estimated to contain 26,000 tons of uranium.

NONMETALS

Barite.—Egypt quarried 746 tons of barite in 1977 for use as a weight material in petroleum drilling muds. Barite was quarried at two main sources, Gebel Hudi near Aswan and Wadi Elba at the southeastern border of Egypt and Sudan. It was transported by railroad to Cairo where it was fine-ground and bagged. Local deposits of barite were considered to be far in excess of production needs.

Cement.—In 1977, Egypt produced 3.3 million tons of cement for local use. Cement production capacity was rated at approximately 4 million tons concentrated in four plants, as follows: Torah Portland Cement Co., 1.4 million tons; Helwân Portland Cement Co., 1.4 million tons; Alexandria Portland Cement Co., 500,000 tons; and National Cement Co. at Assiut, 700,000 tons.

Annual imports of cement were about 1 million tons. To meet a projected domestic cement demand of 10 million tons, plans were made to expand the Alexandria and Assiut plants and to construct new facilities at Torah, Suez, and Nag' Hammadi.

Fertilizer Materials.—Approximately 660,000 tons of nitrogenous fertilizer and 520,000 tons of phosphatic fertilizer were produced in 1977. Egypt continued to be heavily dependent on imported fertilizer and needed to remedy the reduced silt deposition in the Nile Valley since the commissioning of the Aswan Dam. Imports were expected to decline in 1978 owing to the startup of new facilities.

Ammonium nitrate based fertilizers made up the greater part of Egyptian output. The three producing plants were operated by Soc. el-Naşr d'Engrais et d'Industries Chimiques at Suez, El Naşr Co. for Manufacture of Coke & Chemicals at Helwân, and Egyptian Chemical Industries (KIMA) at Aswan. Construction continued on new plants at Talkha, which would use natural gas feedstock from the Abu Madi field, and at Alexandria, which would be supplied by natural gas from the Abu Qir field. The plants were both operated by Soc. el-Naşr d'Engrais et d'Industries Chimiques and would each produce 260,000 tons per year of ammonia and urea by 1978. KIMA also planned a joint venture with Iran for construction of a nitrogenous fertilizer complex at Shuqeir on the Red Sea.

Phosphatic fertilizer was produced by the Abu Zaabal Fertilizer & Chemical Co. plant at Abu Zaabal, the Kosseir Phosphate Co. plant at Kosseir, and the Soc. Financière et Industrielle d'Egypte S.A. plants at Assiut and Kafr-el-Zaiyat. Phosphatic fertilizer

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production capacity was rated at 535,000 tons per year. Abu Zaabal's new triple superphosphate plant was expected to come onstream in 1979 with a capacity of 170,000 tons per year. Cremer and Warner (United Kingdom) was contracted to provide technical assistance for the construction of the plant and handling facilities. Phosphate was to be obtained from the West Sabaya mine in the Nile Valley.

Phosphate Rock.—Phosphate rock production increased from 390,000 tons in 1976 to 470,000 tons in 1977. Approximately 50% of production was exported. Phosphate operations were nationalized in 1956, and mining and marketing was under the control of the Egyptian General Organization for Geological Research and Mining (GOGRM). Phosphate rock production was to be greatly increased in the next 5 years through exploitation of deposits at Hamrawein, Shagila, Abu Tartûr, and El Mahâmid. Egypt's three main areas of phosphate rock deposition were as follows:

1. Red Sea Coast.—Once the center of phosphate mining activity, the Port Safâga and Kosseir mines in the Red Sea area of the Eastern Desert were expected to be depleted by 1980. However, the Hamrawein deposits were under development with Romanian technical assistance. Production at the rate of 1.2 million tons per year was to begin in 1978. Reserves were estimated at 400 million tons. Plans were also under study to exploit the Shagila deposits at a rate of 600,000 tons per year. The People's Republic of China was to finance part of the development cost of Shagila, where reserves were estimated at 300 million tons.

2. Nile Valley.—Estimated reserves in the Nile Valley region between Isna and Idfu north of Aswan were 300 million tons. Production at the El Mahâmid mine was to be increased to 450,000 tons per year. The West Sabaya operation was also to be expanded from 120,000 tons to 500,000 tons per year to supply the Abu Zaabal fertilizer complex.

3. Western Desert.—The phosphate deposits at Abu Tartûr, estimated to contain reserves of 1 billion tons with an average P_2O_5 content of 25.6%, were to be developed by 1985. The engineering design contract was awarded during the year to Sofremines of France and Alusuisse of Switzerland. Abu Tartûr was expected to yield 10 million tons of ore per year to be processed into 7 million tons of phosphate concentrate. Infrastructure requirements included a 600-kilometer railroad to Port Safâga and new port facilities for handling increased phosphate exports.

Gypsum.—Both gypsum and limestone were widely distributed in Egypt and quarried as a source of building stone and raw material for manufacturing cement. Approximately 509,000 tons of gypsum was produced in 1977. Gypsum was quarried at many places associated with anhydrite—on the Gulf of Suez, at Ballah in the Suez Canal area, and at Ras Matarma and Ras Mallap on the Sinai Peninsula. During 1977, a joint venture was established by Egypt and Kuwait to mine gypsum deposits discovered in the Western Desert near Sidi Abdel Rahman. Reserves were estimated at 300 million tons. Approximately 80% of production was to be exported.

MINERAL FUELS

Coal and Coke.—Coke output from the coke and basic chemicals factory at Helwân increased to 694,000 tons in 1977. Further expansion was planned. Egypt has imported all of its coal requirements since the Maghara coal mines on the Sinai Peninsula were closed in 1967. Reserves at the Maghara deposit were estimated at 50 million tons and had previously been mined at the rate of 67,000 tons per year.

Natural Gas.—Egypt marketed approximately 14 billion cubic feet of natural gas in 1977, of which 39% was used by producers, 15% was sold for fuel or raw material, and 46% was used for oilfield reinjection. Natural gas reserves were estimated at 5 trillion cubic feet and were concentrated in four major fields. The Abu Madi, Abu Qir, and Abu al-Gharadiq fields were under development, but there were no immediate plans to utilize gas associated with oil in the El Morgan field in the Gulf of Suez.

In 1977, the Egyptian General Petroleum Authority (EGPA) assumed full ownership of gas reserves at Abu Madi, previously operated by a joint venture of Egyptian General Petroleum Corp. (EGPC) (EGPA's predecessor) and the Italian firm Ente Nazionale Idrocarburi (ENI). Production was to reach a rate of 150 million cubic feet of gas per day by 1978. Output was distributed to local industry in the Cairo area and was to supply the new Talkha fertilizer complex. Reserves were estimated at 1.4 trillion cubic feet.

The Abu Qir field, located offshore Alexandria, was operated by Western Desert Operating Petroleum Co. (WEPCO), a joint venture of EGPA and Phillips Petro-

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leum Co. Production was to begin in 1978 at the rate of 124 million cubic feet of gas per day, to be distributed to the Alexandria industrial area. Reserves were estimated at 1 trillion cubic feet.

A 300-kilometer pipeline linking the Abu al-Gharadiq field with Torah and Helwân was inaugurated in April 1977. The field was operated by Fayoum Petroleum Co. (FAPCO), a joint venture of EGPA and Amoco Egypt Oil Co. Production at the rate of 160 million cubic feet of gas per day was to fuel steel and cement plants. Reserves were estimated at 2.2 trillion cubic feet.

Petroleum.—*Production.*— Petroleum production increased from an average of 329,000 barrels per day in 1976 to 413,500 barrels per day in 1977. Targeted output was 1 million barrels per day by 1980. EGPA supervised all exploration, production, refining, and marketing of petroleum and its products.

Approximately 70% (290,000 barrels per day) of Egypt's petroleum output was produced by Gulf of Suez Petroleum Co. (GUPCO), a joint venture of EGPA and Amoco. Production was from three major fields—El Morgan, July, and Ramadan. At yearend, GUPCO began production from three small fields discovered in the Gulf of Suez over the past 2 years. Combined initial output of the three fields was 32,000 barrels per day, expected to rise gradually to 150,000 barrels per day by 1980.

Cie. Orientale des Pétroles d'Egypte (COPE), a collaboration of EGPA and ENI, produced approximately 67,000 barrels per day of oil at its two groups of oilfields on the Sinai Peninsula. Improvements in facilities were being implemented to raise production to 100,000 barrels per day. In 1977, ENI converted its joint venture with EGPA to a production-sharing agreement by which it would recover its costs in crude oil allotments.

Seven small fields in the Eastern Desert, which produced 29,000 barrels of oil per day in 1977, were operated by General Petroleum Co. (GPC), owned totally by the Egyptian Government. Other small oil-producing companies were WEPCO, FAPCO, and Nile Petroleum Co. (NIPCO).

Exploration.—Approximately 30 foreign companies held exploration permits covering nearly 320,000 square kilometers of onshore and offshore area. It was estimated that $180 million was expended on petroleum exploration in 1977. The production-sharing arrangements provided for the companies to finance all exploration and development costs and to spend a given amount on exploration over a period of up to 12 years. In the case of a commercial discovery, a joint venture with a contractual lifespan of up to 30 years would be formed with EGPA. The foreign company would recover its expenses from an initial allocation of 40% of production; the remaining output would be shared in various proportions with EGPA.

Exploration was being conducted in the following six general areas:

1. Gulf of Suez.—The Gulf of Suez Basin covers an area of nearly 20,000 square kilometers from Suez to Hurghada. Transworld Egypt Petroleum Corp., Deminex A.G., and Egyptian Petroleum Development Co., Ltd. (EPEDECO) (Japan) all reported petroleum discoveries in 1977.

2. Red Sea.—No oil discoveries have yet been made in this 25,000-square-kilometer area extending from Hurghada to the Egyptian-Sudanese border. Companies exploring the tract were Exxon Corp., Union Oil Co. of California, and a joint venture of Phillips and Hispanoil.

3. Western Desert.—The site of the most active exploration was the Western Desert, which covers 500,000 square kilometers south of the Mediterranean coast. The largest tract, covering a total of 390,000 square kilometers, was held by a joint venture of Continental Oil Co. (Conoco), Shell Oil Co., and Marathon Oil Co.

4. Nile Delta.—The Nile Delta, an area covering 36,000 square kilometers including the offshore area, has yielded two gasfields but little oil. In 1977, Murphy Eastern Oil Co. (United Kingdom) acquired a 5,200-square-kilometer concession. Both Mobil Oil Egypt and Conoco were evaluating oil and gas finds in 1977.

5. Nile Valley.—The Nile Valley Basin comprises a 100,000-square-kilometer area bound to the west by the Kharga-Wadi El Rayan uplift and to the east by the Red Sea Hills. TRIPCO Egypt Petroleum Inc. completed reconnaissance and seismic surveys in its 5,000-square-kilometer tract.

6. North Sinai.—The northern portion of the Sinai Peninsula, south to the latitude of Suez and including the Mediterranean offshore area, encompasses a total area of 40,000 square kilometers. Egypt concluded agreements with Conoco, Gulf Oil Corp., Mobil, and a Total/Agip joint venture for exploration in this territory which was recovered from Israel after the 1973 Arab-

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Israeli war. Formal conclusion of these agreements awaited a United Nations decision regarding exploration rights in the Egyptian-Israeli buffer zone.

Refining.—Egypt produced approximately 11 million tons of refined petroleum products in 1977. Plans were made to increase total refining capacity to 15.5 million tons of petroleum products per year through the expansion of existing facilities. The feasibility of building an export refinery at the SUMED pipeline terminal at Sidi Kreir was under study. The refinery would have a capacity of 150,000 barrels per day and would be onstream by 1982. In 1977, refining capacity was concentrated in three companies as follows:

Company	Location	Capacity (million metric tons per year)
Gulf of Suez Petroleum Co	Suez	1.5
	Musturud	3.5
	Tanta	1.5
Nasr Petroleum Co	Suez	1.0
	Amreya	2.2
Alexandria Petroleum Co	Alexandria	2.0

Pipelines.—The SUMED pipeline began regular service in February 1977. The $500 million SUMED system consisted of two 320-kilometer, 42-inch pipelines with a combined capacity of 1.6 million barrels per day (80 million tons per year). SUMED was operated by Arab Petroleum Pipeline Co., owned by Egypt (50%), Saudi Arabia (15%), Kuwait (15%), the United Arab Emirates (15%), and Qatar (5%). By yearend, three service contracts had been concluded, with Mobil, Exxon, and Petrofina, S.A., of Belgium-Luxembourg, to allow the pipeline to operate at 25% of capacity. Other contracts were under negotiation.

Petrochemicals.—Montedison S.p.A. (Italy) was contracted for the construction of a $400 million petrochemical complex at Amreya, near Alexandria. The proposed complex, in which EGPA would have a 75% interest, was to produce 100,000 tons of low-density polyethylene, 30,000 tons of high-density polyethylene, and 60,000 tons of polyvinyl chloride per year. Startup was scheduled for 1982.

[1]Economist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Egyptian pounds (£E) to U.S. dollars at the rate of £E1 = US$2.56.

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The Mineral Industry of Finland

By Joseph B. Huvos[1]

In 1977, Finland, a modest producer of mineral commodities, remained under the influence of a stagnant economy, with 6.2% unemployment and 13% inflation. The gross national product (GNP) was about $29 billion.[2 3] Mining and quarrying contributed about $119 million or 0.4% of the total. The entire mineral industry, including processing of minerals into semifinished products, contributed about 4%. Approximate mining and quarrying employment was 6,000 and for the mineral industry as a whole, about 80,000.

In 1977, important events in Finland's mineral industry included commissioning of additional cobalt production capacity by Outokumpu Oy and startup of Oy Lohja AB's talc-processing plant, Finland's first nuclear powerplant, a new 1,000-megawatt, coal-fired powerplant, and the State Fuel Center's new peat briquet plant. Kemira Oy's apatite project was approved by the Government. Outokumpu Oy completed exploration of a copper-nickel deposit. Neste Oy decided to explore for uranium near Helsinki.

PRODUCTION

Production of mineral commodities is detailed in table 1.

Volume indices (1970=100) of production in the principal sectors of the mineral industry and the country's industry as a whole are shown in the following tabulation:

Sector	1976	1977[p]
Mining and quarrying	100	104
Nonmetallic mineral processing	121	120
Iron and steel	148	182
Nonferrous metals	105	115
Petroleum refining	138	147
Industrial chemicals	170	161
All industry	125	122

[p]Preliminary.

Source: Central Statistical Office of Finland, Helsinki. Bulletin of Statistics. No. 2, 1978, pp. 8-9.

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The following tabulation shows the major producers of mineral commodities:

Commodity	Major producers (ownership)	Principal facilities	Percent of domestic output
Chromite	Outokumpu Oy (Government 51% and National Pension Institute 49%).	Mine at Elijärvi-Kemi	100
Cobalt ore	do	Mines at Keretti and Vuonos	100
Copper-nickel ore	do	Mines at Keretti, Vihanti, Virtasalmi, Hitura, Kotalahti, Vuonos; smelter and refinery at Harjavalta.	95
Iron ore	Rautaruukki Oy (Government 98%).	Mines at Rautavaara, Mustavaara, Otanmäki	100
Iron and steel	do	Plant at Raahe	72
	Ovako Oy	Plants at Imatra, Turku, Lappvik, Aminnefors	23
	Outokumpu Oy	Plant at Tornio	2
Lead-zinc ore	do	Mines at Vuonos, Pyhäsalmi, Hammaslahti, Vihanti	90
	Myllykoski Oy	Mine at Luikonlahti	10
Petroleum products.	Neste Oy (Government 98%)	Refineries at Porvoo and Naantali	100
Vanadium ore	Rautaruukki Oy	Iron mines at Mustavaara and Otanmäki	100
Zinc, smelter	Outokumpu Oy	Plant at Kokkola	100

Table 1.—Finland: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Aluminum, secondary	5,300	6,100	7,400
Cadmium metal, refined	217	428	527
Chromium, chromite:			
Gross weight:			
Concentrate	131,567	143,302	145,131
Foundry sand	33,026	31,567	23,740
Cr_2O_3 content:			
Concentrate	52,890	57,894	59,939
Foundry sand	15,291	14,679	11,087
Cobalt:			
Mine output, metal content	[r]1,256	1,279	1,227
Metal, refined	821	892	985
Copper:			
Mine output, metal content	[r]38,646	41,729	46,728
Metal:			
Primary:			
Blister	46,930	51,516	61,542
Electrolytic	35,764	38,149	42,755
Secondary (unrefined)	11,335	9,527	10,563
Gold metal, troy ounces	22,216	26,299	27,392
Iron and steel:			
Iron ore:			
Magnetite concentrate, thousand tons	376	599	739
Pelletized iron oxide (from pyrite), do	280	328	147
Roasted pyrite (purple ore), do	[r]532	568	402
Metal:			
Pig iron, do	1,368	1,329	1,763
Ferrochromium, do	40	40	34
Steel, crude:			
Ingots, do	1,579	1,614	2,171
Castings, do	39	30	25
Semimanufactures (rolled), do	1,087	1,161	1,518
Lead, mine output, metal content	929	1,131	628
Mercury, 76-pound flasks	309	383	630
Nickel:			
Mine output, metal content	[r]5,299	6,358	5,837
Sulfate, metal content	207	190	223
Metal, electrolytic	6,544	7,624	9,447
Platinum metal[e], troy ounces	600	640	720
Selenium metal, kilograms	8,477	9,931	11,654
Silver metal, troy ounces	743,839	773,256	812,898
Titanium concentrate: Ilmenite, gross weight	122,600	122,600	124,700
Vanadium pentoxide:			
Gross weight	2,276	2,589	3,328
V content	1,275	1,450	1,864
Zinc:			
Mine output, metal content	54,356	61,143	62,856
Metal	109,885	110,633	137,980
Semimanufactures	122	105	--

See footnotes at end of table.

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Table 1.—Finland: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
NONMETALS				
Asbestos		2,788	--	--
Cement, hydraulic	thousand tons	2,063	1,825	1,712
Feldspar		68,577	68,213	71,890
Fertilizer materials:				
Natural, phosphatic (apatite)	thousand tons	[r]2	4	3
Manufactured:				
Nitrogenous	do.	[e]300	NA	NA
Phosphatic (superphosphate)	do.	[e]60	NA	NA
Mixed and other	do.	[e]1,000	NA	NA
Lime	do.	259	250	235
Pyrite:				
Gross weight	do.	[r]519	494	295
S content	do.	[r]246	234	130
Stone:				
Limestone and dolomite:				
For cement	do.	2,861	2,394	2,535
For lime	do.	482	462	430
For sulfite and metallurgical use	do.	128	128	98
Other	do.	893	1,267	901
Quartz	do.	105	109	119
Sulfur, byproduct (recovered):				
Elemental		84,409	85,733	29,126
Gaseous (in SO_2)		261,624	282,634	280,379
Talc		124,260	148,531	156,584
Wollastonite		13,089	6,165	8,904
MINERAL FUELS AND RELATED MATERIALS				
Gas, manufactured	million cubic feet	959	NA	NA
Peat:				
For fuel use	thousand tons	200	360	600
For agricultural and other use	do.	165	198	231
Petroleum refinery products:				
Gasoline	thousand 42-gallon barrels	11,837	14,235	15,630
Kerosine	do.	134	30	34
Jet fuel	do.	1,665	1,554	1,582
Distillate fuel oil	do.	18,517	23,990	29,060
Residual fuel oil	do.	20,833	27,255	27,330
Liquefied petroleum gas	do.	983	1,007	1,163
Other	do.	2,726	5,506	8,539
Refinery fuel and losses	do.	3,402	8,203	5,269
Total	do.	60,097	81,780	88,607

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

TRADE

There was no significant change in the country's trade pattern in 1977. The balance-of-trade deficit decreased to about $60 million. The principal mineral exports, going mainly to Western Europe, were iron and steel, cobalt, copper, nickel, vanadium, zinc, feldspar, and talc. Mineral commodity imports made up about one-third of the value of all imports, with fuels and power accounting for about 23% of the total. Major mineral imports from the United States were steel semimanufactures, nonferrous metal ores, and nonferrous scrap. Mineral exports to the United States included steel semimanufactures, nickel and zinc metals, and other base metals including alloys. United States-Finnish trade in 1976 is shown in table 4. Finland's mineral commodity trade in 1975 and 1976 is shown in tables 2 and 3.

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Table 2.—Finland: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal including alloys:			
Scrap	34	17	NA.
Unwrought	548	1,195	Sweden 553; United States 511.
Semimanufactures	13,691	15,621	Sweden 3,347; Denmark 3,287; Netherlands 2,867.
Arsenic trioxide, pentoxide, acids	(1)	--	
Cadmium metal including alloys, all forms	189	450	Sweden 231; United Kingdom 114; Netherlands 35.
Chromium, chromite	150,421	291,483	Sweden 135,665; United States 113,558.
Cobalt metal, unwrought and semimanufactures	810	811	Canada 304; United Kingdom 196; Japan 101.
Copper:			
Ore and concentrate	78	--	
Metal including alloys:			
Scrap	1,930	1,000	Sweden 595; Poland 279; Denmark 106.
Unwrought, including matte	14,457	23,651	West Germany 9,620; Belgium-Luxembourg 6,154; Netherlands 2,540.
Semimanufactures	14,762	19,345	Sweden 5,492; West Germany 3,964; Denmark 2,970.
Gold metal, unworked or partly worked troy ounces	r7,678	1,244	United Kingdom 965; East Germany 228.
Iron and steel:			
Ore and concentrate, except roasted pyrite	862	--	
Roasted pyrite	--	18	NA.
Metal:			
Scrap	5,106	3,688	West Germany 2,866; U.S.S.R. 573.
Pig iron, ferroalloys, similar materials	126,624	117,953	Sweden 48,617; United Kingdom 24,900; Switzerland 9,039.
Steel, primary forms	237,810	232,818	Sweden 127,906; West Germany 58,517; United Kingdom 36,238.
Semimanufactures	206,862	349,473	Sweden 61,476; Norway 43,336; West Germany 34,804.
Lead:			
Ore and concentrate	NA	4,089	All to Belgium-Luxembourg.
Metal including alloys:			
Scrap	408	130	Netherlands 20; West Germany 19.
Unwrought	r65	10	NA.
Semimanufactures	8	16	Sweden 10.
Mercury 76-pound flasks	r122	183	United Kingdom 70; Sweden 46.
Nickel metal including alloys:			
Unwrought	5,862	6,143	France 1,212; United Kingdom 890; Norway 626.
Semimanufactures	141	6	Denmark 2.
Platinum-group metals including alloys troy ounces	r1,241	2,080	East Germany 2,067.
Silver metal including alloys thousand troy ounces	r610	223	East Germany 107; Sweden 103; United Kingdom 8.
Tin metal including alloys:			
Scrap	12	17	Netherlands 11; East Germany 6.
Unwrought	2	79	Sweden 57; Netherlands 22.
Semimanufactures	r3	2	Mainly to Sweden.
Titanium oxide	2,268	3,070	NA.
Uranium oxide	2,407	2,571	Sweden 718; East Germany 541; France 506.
Zinc:			
Ore and concentrate	3,660	--	
Oxide	(1)	227	Israel 217; Sweden 10.
Metal:			
Scrap	376	956	United Kingdom 602; Netherlands 209; Pakistan 100.
Unwrought	79,766	109,255	United Kingdom 32,820; United States 21,149; Sweden 15,361.
Semimanufactures	r1,820	156	United Kingdom 109; Saudi Arabia 38; Kuwait 9.
Other:			
Ash and residue containing nonferrous metals	2,381	3,369	Denmark 2,031; East Germany 873; Sweden 243.
Waste and sweepings of precious metals kilograms	r7,213	1,616	Sweden 585; United Kingdom 520; France 257.
Base metals	1	--	
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice	(1)	--	
Grinding and polishing wheels and stones	33	15	United States 8; Sweden 4.
Asbestos	3,512	--	
Borates, crude, natural	450	--	
Cement	16,772	9,121	Sweden 5,115; U.S.S.R. 2,811.

See footnotes at end of table.

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Table 2.—Finland: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Clays and clay products (including all refractory brick):			
Crude:			
Kaolin	(1)	20	NA.
Other	304	3,147	Sweden 3,108.
Products:			
Refractory	r347	622	East Germany 427; United States 80; United Kingdom 52.
Nonrefractory	128	1,754	Sweden 1,306; U.S.S.R. 309; Norway 121.
Diamond, natural and manufactured, gem and industrial thousand carats	NA	164	United States 109.
Diatomite and other infusorial earth	10	34	Sweden 26.
Feldspar	49,169	51,681	United Kingdom 34,169; Hungary 1,541; Malaysia 1,394.
Fertilizer materials, manufactured:			
Nitrogenous	9,038	1,281	Netherlands 1,250.
Potassic	29	--	
Other, including mixed	44	10,125	Kenya 10,000; Iran 45; Libya 9.
Lime	900	15	NA.
Precious and semiprecious stones, except diamond:			
Natural kilograms	38	333	Sweden 174; United States 72.
Manufactured do	(1)	22	All to United States.
Salt, excluding brine	(1)	6	NA.
Sodium and potassium compounds: Caustic soda	169	782	All to Sweden.
Stone, sand and gravel:			
Dimension stone	r45,310	59,891	Italy 24,608; France 10,637; East Germany 8,124.
Other stone:			
Dolomite	12	87	NA.
Limestone	15,831	13,652	Sweden 12,461; Denmark 1,008; U.S.S.R. 183.
Quartz and quartzite	480	345	Sweden 338.
Crushed and broken stone and gravel, n.e.s	20,316	8,747	Sweden 6,344; U.S.S.R. 2,316.
Sand, excluding metal bearing	673	161,208	Sweden 160,935; United Arab Emirates 250.
Sulfur:			
Elemental, all forms	r10,924	17,630	Sweden 8,430; Spain 4,397; Norway 3,874.
Sulfuric acid	80,690	202,953	Netherlands 67,369; United Kingdom 46,942; Spain 26,671.
Talc and steatite	4,750	11,189	U.S.S.R. 4,004; Poland 3,577; Sweden 866.
Other:			
Crude, unspecified	3,312	4,589	East Germany 1,409; Spain 986; Italy 776.
Slag, dross, and similar waste, not metal bearing:			
From iron and steel manufacture	2,345	--	
Slag and ash, n.e.s	(1)	105	NA.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	r830	14	Sweden 10.
Hydrogen, helium, rare gases	(1)	--	
Peat, including peat briquets and litter	8,657	--	
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	r1,079	3	East Germany 1.
Distillate fuel oil do	(1)	250	East Germany 132; Denmark 109; U.S.S.R. 6.
Lubricants do	r61	78	U.S.S.R. 42; Belgium-Luxembourg 17; Sweden 12.
Other:			
Liquefied petroleum gas do	NA	11	Sweden 10.
Mineral jelly and wax do	r26	71	East Germany 29; Italy 15; France 14.
Nonlubricating oils, n.e.s do	NA	(1)	NA.
Bitumen and bituminous mixtures, n.e.s do	55	37	U.S.S.R. 26; Sweden 1.
Unspecified do	(1)	--	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	--	1	NA.

rRevised. NA Not available.
[1]Less than 1/2 unit.

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Table 3.—Finland: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Ore and concentrate	r9,878	2,442	Mainly from Greece.
Oxide and hydroxide	24,741	22,575	Hungary 11,676; People's Republic of China 5,100; West Germany 4,287.
Metal including alloys:			
Unwrought	19,168	24,467	Norway 7,327; U.S.S.R. 6,217; Ghana 2,571.
Semimanufactures	20,842	26,036	Sweden 4,487; Norway 2,467; Hungary 1,781.
Antimony metal including alloys, all forms	8	6	Sweden 5.
Arsenic trioxide, pentoxide, acids	719	836	Sweden 783.
Cadmium metal including alloys, all forms	1	--	
Chromium:			
Chromite	--	24	NA.
Oxide and hydroxide	r1,868	386	West Germany 243; U.S.S.R. 74; Poland 60.
Cobalt:			
Oxide and hydroxide	19	53	Mainly from Sweden.
Metal including alloys, all forms	5	3	Belgium-Luxembourg 2.
Copper:			
Ore and concentrate	2,878	15,805	Papua New Guinea 15,020.
Copper sulfate	2,906	532	U.S.S.R. 475; United Kingdom 25; Sweden 16.
Metal including alloys:			
Scrap	121	780	Sweden 478; United States 297.
Unwrought	14,643	17,171	U.S.S.R. 5,332; Sweden 5,328; Zambia 4,371.
Semimanufactures	9,919	20,865	Sweden 2,079.
Gold metal, unworked or partly worked, troy ounces	r57,489	96,815	East Germany 66,713; United Kingdom 12,954; Switzerland 8,661.
Iron and steel:			
Ore and concentrate, except roasted pyrite	r1,206,359	972,529	Sweden 516,388; Norway 180,290; U.S.S.R. 169,997.
Metal:			
Scrap	94,939	54,191	Mainly from U.S.S.R.
Pig iron, including cast iron	52,187	371	Norway 310.
Sponge iron, powder, shot	4,983	5,065	Sweden 2,566; United Kingdom 1,036; Spain 673.
Ferroalloys	24,694	23,983	Norway 11,585; U.S.S.R. 6,126; Sweden 2,201.
Steel, primary forms	24,018	71,677	Mainly from Sweden.
Semimanufactures:			
Bars, rods, angles, shapes, sections	290,261	196,909	West Germany 47,777; Sweden 45,094; Norway 20,382.
Universals, plates, sheets	200,687	183,000	NA.
Hoop and strip	38,153	27,000	NA.
Rails and accessories	17,338	16,000	NA.
Wire	18,435	15,000	NA.
Tubes, pipes, fittings	127,438	112,000	NA.
Castings and forgings, rough	1,341	--	
Lead:			
Ore and concentrate	--	4,089	All from Belgium-Luxembourg.
Oxide	281	237	West Germany 113; East Germany 60; Belgium-Luxembourg 56.
Metal including alloys:			
Unwrought	13,982	14,606	U.S.S.R. 6,980; Sweden 4,781; United Kingdom 885.
Semimanufactures	975	623	East Germany 284; Denmark 142; United Kingdom 110.
Magnesium metal including alloys, all forms	71	92	Norway 64; East Germany 14.
Manganese:			
Ore and concentrate	4	27,813	Ghana 11,969; Sweden 9,995.
Oxide	1,652	563	Netherlands 209; Ghana 162; Belgium-Luxembourg 117.
Mercury, 76-pound flasks	1,392	586	Spain 273; Italy 189; Mexico 52; Japan 5.
Molybdenum metal including alloys, all forms	3	74	United States 39; Sweden 22; Belgium-Luxembourg 11.
Nickel:			
Ore and concentrate	10,276	12,876	All from Norway.
Metal including alloys:			
Scrap	86	327	Sweden 197; United States 79; Poland 31.
Unwrought	297	1,587	French territories in the Caribbean 1,425; Netherlands 63; United States 59.
Semimanufactures	116	60	West Germany 21; Australia 8.
Platinum-group metals, thousand troy ounces	7	23	Sweden 18; U.S.S.R. 3.
Silver metal including alloys, do.	r2,667	2,522	East Germany 1,317; United Kingdom 865; Netherlands 150.
Silicon, elemental	367	381	Sweden 360; Norway 20.

See footnotes at end of table.

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Table 3.—Finland: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Tin:			
Oxide	3	12	All from United Kingdom.
Metal including alloys:			
Unwrought	172	233	United Kingdom 59; People's Republic of China 45; Denmark 45.
Semimanufactures	r125	140	United Kingdom 77; East Germany 25; Sweden 17.
Titanium:			
Ore and concentrate	15,282	3,315	Norway 3,000; Australia 300; Sweden 10.
Oxide	124	71	Netherlands 20; Japan 19; Norway 15.
Tungsten:			
Ore and concentrate	2	--	
Metal including alloys, all forms	r20	27	United Kingdom 10; France 6; United States 3.
Zinc:			
Ore and concentrate	121,358	110,391	Peru 50,803; Denmark 43,876; Sweden 15,712.
Oxide	510	288	United Kingdom 195; United States 40; France 30.
Metal including alloys:			
Scrap	31	956	United Kingdom 602; Netherlands 209; Pakistan 100.
Blue powder	375	--	
Unwrought	2,488	3,104	Mexico 1,753; United Kingdom 688; Netherlands 209.
Semimanufactures	r174	624	Norway 309; Sweden 100; East Germany 70.
Other:			
Ores and concentrates	18,626	22,363	Sweden 11,946; United States 10,317; Czechoslovakia 100.
Ash and residue containing nonferrous metals	2,460	7,180	East Germany 3,513; Republic of South Africa 206; Sweden 115.
Metals including alloys, all forms:			
Metalloids, n.e.s	10	8	Austria 4; Brazil 2.
Pyrophoric alloys	1	2	Mainly from Austria and United Kingdom.
Base metals, n.e.s	198	124	United Kingdom 57; Sweden 30; United States 12.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	109	102	East Germany 41.
Dust and powder of precious and semiprecious stones, except diamond kilograms	1	2	NA.
Grinding and polishing wheels and stones	2,472	1,828	Austria 337; United Kingdom 298; Sweden 264.
Asbestos	10,132	5,790	Canada 2,011; U.S.S.R. 1,810; Republic of South Africa 1,232.
Barite and witherite	2,038	1,272	East Germany 1,104; United Kingdom 120; People's Republic of China 45.
Borates, crude, natural	12,086	9,349	United States 7,249; Turkey 2,000; Bolgium-Luxembourg 100.
Cement	28,211	8,554	United Kingdom 4,609; Sweden 1,126.
Chalk	6,546	11,893	United Kingdom 4,499; East Germany 2,394; Denmark 2,215.
Clays and clay products (including all refractory brick):			
Crude:			
Kaolin	221,628	290,678	United Kingdom 287,959; West Germany 2,105; United States 504.
Other	r38,694	18,906	United Kingdom 8,555; United States 5,639; East Germany 3,747.
Products:			
Refractory (including nonclay brick)	r69,464	56,040	West Germany 17,537; United Kingdom 14,429; U.S.S.R. 9,608.
Nonrefractory	9,759	6,896	U.S.S.R. 4,394; Sweden 1,037; East Germany 446.
Cryolite and chiolite	70	56	All from Denmark.
Diamond, industrial carats	r24,500	79,500	Netherlands 17,000; United Kingdom 5,000.
Diatomite	1,115	1,077	United States 590; Iceland 200; United Kingdom 200.
Feldspar, leucite, nepheline syenite	47	27	NA.

See footnotes at end of table.

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Table 3.—Finland: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Fertilizer materials:			
Crude, phosphatic	623,003	337,962	U.S.S.R. 186,357; Senegal 71,765; Morocco 57,701.
Manufactured:			
Nitrogenous	r18,777	22,726	U.S.S.R. 8,004; Norway 5,556; Sweden 2,838.
Phosphatic	690	284	Netherlands 200; East Germany 50; United Kingdom 33.
Potassic	r305,910	205,857	U.S.S.R. 81,620; East Germany 62,966; West Germany 42,746.
Other, including mixed	1,396	627	Belgium-Luxembourg 353; United Kingdom 126; West Germany 50.
Ammonia	46,069	53,663	U.S.S.R. 52,467; Netherlands 1,191.
Fluorspar	4,385	3,775	Spain 1,079; Netherlands 1,034; East Germany 553.
Graphite, natural	516	188	East Germany 62; United Kingdom 58; Sweden 46.
Gypsum and plaster	151,672	123,673	Poland 56,202; Spain 31,481; U.S.S.R. 27,933.
Lime	20	17	NA.
Magnesite	1,958	2,397	Austria 1,905; People's Republic of China 365; Netherlands 50.
Mica, all forms	255	267	United Kingdom 159; Norway 31; India 14.
Phosphorus, elemental	5	2	All from East Germany.
Pigments, mineral:			
Natural, crude	95	89	Hungary 55; United Kingdom 20.
Iron oxides, processed	2,507	2,864	East Germany 2,599; Spain 94; People's Republic of China 60.
Precious and semiprecious stones, except diamond:			
Natural kilograms	3,113	2,291	East Germany 664; Austria 85; Switzerland 76.
Manufactured do	159	125	Switzerland 76; East Germany 20.
Salt, excluding brine	513,996	480,889	Netherlands 281,451; West Germany 46,052; United Kingdom 41,584.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	17,977	44,492	Sweden 14,155; Belgium-Luxembourg 13,396; United Kingdom 5,962.
Caustic potash	474	467	East Germany 162; West Germany 95; Sweden 79.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	287	606	Denmark 200; Norway 130; Italy 117.
Worked	295	208	Sweden 121; Italy 52.
Dolomite, chiefly refractory grade	7,362	11,553	Belgium-Luxembourg 9,420; Sweden 1,095; East Germany 648.
Gravel and crushed rock	12,870	7,975	Sweden 4,929; Norway 2,618; Bulgaria 150.
Limestone, except dimension	404,151	392,724	Sweden 390,018; United Kingdom 2,576.
Quartz and quartzite	567	94	United States 24.
Sand, excluding metal bearing	86,120	68,222	Belgium-Luxembourg 55,771; Sweden 5,171; Denmark 4,164.
Sulfur:			
Elemental	r31,981	12,427	France 8,439; Poland 3,599; East Germany 205.
Sulfuric acid	r191	73	NA.
Talc and steatite	822	715	Belgium-Luxembourg 364; East Germany 112; Norway 105.
Other:			
Crude	1,075	2,547	East Germany 1,149; Sweden 553; Netherlands 486.
Slag, dross, and similar waste, not metal bearing:			
From iron and steel manufacture	23,680	14,959	Sweden 7,701; Switzerland 4,870; Norway 1,800.
Slag and ash, n.e.s	115	140	NA.
Oxides and hydroxides of magnesium, strontium, barium	14,797	9,493	U.S.S.R. 4,581; People's Republic of China 2,694; Norway 922.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	r4,977	2,582	Denmark 883; East Germany 579; Sweden 412.

See footnotes at end of table.

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Table 3.—Finland: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	263	386	Trinidad and Tobago 288; United States 85.
Carbon black and gas carbon	6,804	6,219	Sweden 2,194; East Germany 1,521; United Kingdom 1,372.
Coal, all grades, including briquets thousand tons	r3,847	2,782	Poland 2,256; U.S.S.R. 523.
Coke and semicoke do.	889	921	U.S.S.R. 646; United Kingdom 103; Poland 89.
Gas, natural million cubic feet	23,670	28,849	All from U.S.S.R.
Hydrogen, helium, rare gases	85	105	Netherlands 36; Denmark 34; Sweden 21.
Peat, including peat briquets and litter	1,907	1,706	NA.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	r70,850	81,862	U.S.S.R. 51,365; Saudi Arabia 21,967; Iran 5,926.
Refinery products:			
Gasoline do.	r364	(1)	Mainly from East Germany.
Kerosine do.	r187	(1)	Mainly from U.S.S.R.
Jet fuel do.	NA	(1)	Mainly from Netherlands.
Distillate fuel oil do.	r14	10	NA.
Residual fuel oil do.	7,373	9,374	Mainly from U.S.S.R.
Lubricants do.	r793	655	United Kingdom 163; U.S.S.R. 159; Netherlands 108.
Other:			
Liquefied petroleum gas do.	r40	68	U.S.S.R. 54; United Kingdom 13.
White spirit do.	r187	--	
Mineral jelly and wax do.	r168	139	U.S.S.R. 67; East Germany 29.
Nonlubricating oils, n.e.s do.	NA	21	United Kingdom 14; Norway 2; Sweden 2.
Bitumen and bituminous mixtures, n.e.s do.	r392	56	Sweden 49; United Kingdom 3.
Pitch, pitch coke, petroleum coke do.	r9	1	All from East Germany and United Kingdom.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	20,400	17,817	U.S.S.R. 7,619; Poland 6,787.

rRevised. NA Not available.
1Less than 1/2 unit.

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Table 4.—Finland: Mineral trade with the United States, 1976[1]

Commodity	Exports		Imports	
	Quantity (metric tons)	Value, thousands	Quantity (metric tons)	Value, thousands
METALS				
Aluminum metal including alloys	512	$360	122	$337
Copper metal including alloys	372	691	480	863
Iron and steel metal:				
Ferroalloys	--	--	15	122
Semimanufactures:				
Bars and angles	3,093	1,092	3	12
Plates and sheets	23,478	4,821	54	78
Wire	83	45	352	649
Tubes and pipes	NA	1	979	2,685
Castings and forgings	--	--	NA	2
Lead metal including alloys	--	--	18	23
Lead-zinc ores and concentrates	--	--	4,926	1,500
Nickel:				
Ore and concentrate	41	175	--	--
Metal including alloys	770	3,529	(2)	6
Platinum and silver ores	NA	193	--	--
Radioactive and associated materials	--	--	4	27
Zinc metal including alloys	28,600	23,006	--	--
Other nonferrous metals:				
Ores and concentrates, n.e.s	110,675	5,899	--	--
Metals:				
Base metals including alloys, n.e.s	142	4,047	3	58
Scrap	--	--	1,978	1,292
NONMETALS				
Abrasives, natural, including diamond	--	--	1,053	236
Clays and refractory materials	--	--	5,778	382
Diamond and precious stones:				
Industrial diamond	NA	121	--	--
Gem diamond and precious stones	NA	11	--	--
Stone, sand and gravel:				
Dimension stone	56	24	--	--
Crushed and broken stone, sand and gravel	113	20	99	32
Sulfuric acid	15,717	283	--	--
Other, crude	4	1	--	--
MINERAL FUELS AND RELATED MATERIALS				
Coal, all types	14	5	--	--
Petroleum refinery products:				
Lubricants	--	--	445	620
Petroleum jelly and mineral waxes	NA	(2)	--	--
Petroleum coke, asphalt, etc	--	--	262	180
Total	XX	44,324	XX	9,104

NA Not available. XX Not applicable.
[1]Data may differ from those reported elsewhere in this chapter owing to a difference in source.
[2]Less than 1/2 unit.

Source: U.S. Department of Commerce, Bureau of the Census.

COMMODITY REVIEW

METALS

Cobalt and Molybdenum.—Outokumpu Oy increased the cobalt production capacity of its Kokkola plant, located on the Gulf of Bothnia, from 1,000 tons to 1,500 tons per year at a cost of $10 million. The increase in capacity was made possible partly through an agreement between Outokumpu Oy and the Government of the German Democratic Republic for the purchase of 40,000 tons of copper smelting residues per year for 8 years, valued at $100 million. The residues contain copper, cobalt, nickel, molybdenum, gold, and silver. Molybdenum, a new product at Kokkola, is to be produced at the rate of 500 tons per year for the company's Tornio stainless steel plant. The copper, nickel, gold, and silver are to be extracted at the company's Harjavalta and Pori plants near the Gulf of Bothnia.

Copper, Lead, Nickel, Zinc.—In 1977, plans were made to reopen an old silver mine on the island of Attu in the archipelago off Pori Province in southwestern Finland, for recovering the lead and zinc found there.

Exploration for copper and nickel in Vammala, east of Tampere, was completed by Outokumpu Oy in 1977. Under study was a $17.5 million project for the production of 200,000 tons of ore per year containing 0.4%

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nickel and 0.3% copper.

Two major companies constituted the industry. Outokumpu Oy continued operating nine of the country's complex sulfide ore mines and controlled mineral-processing plants including the Harjavalta and Pori smelters and the Kokkola zinc smelter, all located in eastern Finland. Myllykoski Oy operated one copper mine at Luikonlahti and sold concentrates produced by the mine to Outokumpu Oy for processing.

Iron Ore.—Iron ore imports from Sweden are to be replaced in 1980 by ore mined at Polvijärvi in the U.S.S.R. near the Finnish border. The ore is to be shipped to Finland in the form of iron pellets. Iron ore mines of Rautaruukki Oy, the sole producer, have been uneconomic, and the Kolari mine is expected to be closed down in 1978; the company's Otanmäki and Mustavaara mines are economic only because of the vanadium pentoxide byproduct.

Iron and Steel.—At yearend, Ovako Oy bought out the Swedish Stora Kopparbergs Bergslags AB's half of the Lappvik steelworks located near Hangö, on the southern coast of Finland, thus becoming the sole owner. In 1977, the plant produced 335,000 tons of wirebar; 70% of this was for export.

In 1977, Finland's steel production was in the hands of four companies that shared an extensive product division, enabling them to survive the steel slump. State-owned Rautaruukki Oy's Raahe works accounted for over 72% of the country's steel output, Ovako Oy's plants 23%, and Outokumpu Oy's plant at Tornio and the Värtsilä concern at Dalsbruk, southern Finland, about 2% and 3%, respectively.

Titanium.—In 1977, Kemira Oy processed in its plant near Pori a byproduct ilmenite concentrate from Rautaruukki Oy's Otanmäki mine, augmented by some imported ilmenite concentrate. Most of the titanium pigment product was exported.

Vanadium.—In 1977, Rautaruukki Oy was Europe's largest producer of vanadium pentoxide and exported to ferroalloy manufacturers in the Federal Republic of Germany, the United Kingdom, France, Sweden, the U.S.S.R., and Czechoslovakia. The company's Otanmäki mine in central Finland and the Mustavaara mine farther north produced vanadium pentoxide as a byproduct of iron ore mining. Initial difficulties at the Mustavaara mine, which started operating in 1976, were overcome, raising the company's capacity to 5,200 tons of vanadium pentoxide per year.[4]

NONMETALS

Apatite.—The Finnish Government approved State-controlled Kemira Oy's plans for the construction of an apatite mine and concentrator at Siilinjärvi, north of Kuopio. Work started on road and rail connections to the plant site, and production is due to start by the end of 1979. Capacity was to be 2 million tons of raw ore or 215,000 tons of apatite concentrate.[5] Proved reserves were evaluated at 500 million tons of ore with an average apatite content of 10%. The concentrate produced was to replace all apatite imports from the U.S.S.R. and 40% of all other apatite imports by 1978. About 165,000 tons of calcite and some potash were byproducts.

An apatite deposit located at Sokli in Kuopio Province was under study by Rautaruukki Oy with the help of Soviet experts for a fee of $3.5 million. In 1978, exploration was to be intensified and a $7.5 million pilot plant was to be built. Rautaruukki Oy was waiting for the Government to subsidize transportation costs and for more favorable phosphate prices on the world market before investing the $250 million needed for a project large enough to supply all Finnish phosphate needs.

Cement.—In 1977, there were four cement plants in Finland, with capacities totaling 2.7 million tons. Oy Lohja AB operated an 850,000-ton-per-year plant at Virkby near Helsinki. Paraisten Kalkki Oy operated a 190,000-ton-per-year plant at Kolari in the Lappland region and the Lappeenranta and Pargas plants on the southern coast, with capacities of 460,000 tons and 1.2 million tons, respectively.

Pyrite and Sulfuric Acid.—Pyrite concentrates from Myllykoski Oy's Luikonlahti mine, located near Kaavi, were roasted for sulfuric acid at Kemira Oy's Siilinjärvi fertilizer plant. About 150,000 tons of roasted pyrite was sold for iron production. Smelter gases at Harjavalta, Kokkola, and Siilinjärvi were converted by Kemira Oy into sulfuric acid at a rate of about 1 million tons of acid per year.

Stone.—In 1977, Finland operated 12 major limestone, dolomite, and wollastonite mines—6 by Paraisten Kalkki Oy, 3 by Oy Lohja AB, and 1 each by Ruskealan Marmori Oy, Rauma-Repola Oy, and Oy K. Forström AB.

Talc.—Production of micronized talc started at Oy Lohja AB's new $10 million micronized talc facility at Vuonos near

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Table 5.—Finland: Supply and apparent consumption of fuels and power for 1976 and 1977

(Million tons of standard coal equivalent[1])

	Total energy	Coal and coke	Petroleum and refinery products	Natural gas	Fuelwood, wood waste, industrial waste[e]	Peat	Hydroelectric power	Nuclear power[e2]
1976:								
Production[3]	r4.5	--	--	--	2.1	e1.2	1.2	--
Imports	26.4	3.7	21.3	0.9	--	--	.5	--
Exports	1.5	--	1.5	--	--	--	--	--
Apparent consumption	r29.4	3.7	19.8	.9	2.1	e1.2	1.7	--
1977:								
Production[3]	4.8	--	--	--	2.1	1.2	1.5	--
Imports	28.4	5.2	22.0	.7	--	--	.2	0.3
Exports	2.3	--	2.2	--	--	--	.1	--
Apparent consumption	30.9	5.2	19.8	.7	2.1	1.2	1.6	.3

eEstimate. rRevised.
[1]1 ton standard coal equivalent (SCE)=7,000,000 kilocalories.
[2]Thermal burnoff of imported uranium fuel.
[3]Includes only primary fuels and power.

Sources: Foreign Trade, Monthly Bulletin. December 1977, p. 15.
Central Statistical Office of Finland, Helsinki. Bulletin of Statistics. No. 1, 1978, pp. 8-9.

Outokumpu. The capacity of the plant was to be expanded to 230,000 tons per year in 1978. Feed came from Polvijärvi, located at a distance of 20 kilometers, and reserves were evaluated at 40 million tons containing about 60% talc, 40% calcite, and 0.18% nickel; the nickel was separated at Vuonos and processed further by Outokumpu Oy. Some nickel-bearing talc was also mined at Lahnalampi near Sotkamo and Polvijärvi near Lohja. Both ores were concentrated at the Vuonos plant.

MINERAL FUELS

In 1977, Finland remained about 85% dependent on imported fuels, mostly crude oil and coal, with a major share of the oil and all of the natural gas supplied by the U.S.S.R. Domestic fuel production was mainly of hydroelectric power, peat, fuelwood, and industrial waste. Table 5 shows the supply and apparent consumption of fuels and power for 1976 and 1977.

Coal.—At yearend, Imatran Voima Oy (IVO), the Finnish electric utility company, commissioned a 1,000-megawatt, coal-fired powerplant at Inkoo, west of Helsinki, to be operated entirely with imported coal.

Nuclear Power.—In January, Finland's first nuclear powerplant became operational at Lovisa, 90 kilometers east of Helsinki, operated by IVO. The two 440-megawatt reactors (the first of which came onstream in 1977) were built by Atomenergoexport of the U.S.S.R. Construction continued at the country's second nuclear powerplant site at Olkiluoto on the western coast near Rauma, being built for Teollisuuden Voima Oy, which is owned predominantly by private industrial groups. Two 660-megawatt-electric units were to be supplied by Almänna Svenska Elektriska AB (ASEA)-Atom of Sweden. Fuel for the plant is to be supplied mainly by Canada and is to be enriched in the U.S.S.R. and fabricated in Sweden.

Helsingin Seudun Lampovoima Oy, jointly owned by IVO and four cities of greater Helsinki, was formed for the purpose of building a 3,000-megawatt-electric nuclear powerplant. The plant was to heat the district and generate 1,000 megawatts-electric of power.

Peat.—A 30,000-ton-per-year peat briquet plant started production for the State Fuel Center in 1977 at Peräseinäjoki in southwestern Finland; a 30,000-ton-per-year peat coke plant also operated at the same site.

Petroleum and Natural Gas.—Neste Oy, the Government-controlled oil company, operated the country's only two oil refineries, at Porvoo and Naantali in southern Finland, with capacity totaling 15 million tons per year. The refineries processed imported crude, much of it supplied by the U.S.S.R., which also supplied, by pipeline, all gas imports to the country.

Uranium.—Neste Oy, the State-owned oil-refining monopoly, planned to explore for uranium at Junninsuo near Mäntsälä, north of Helsinki. Another area of interest for uranium ores was the eastern part of Uusimaa Province.

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[1]Physical scientist, Branch of Foreign Data.
[2]Where necessary, values have been converted from Finnish markka (Fmk) to U.S. dollars at the rate of Fmk4.20=US$1.00.
[3]U.S. Embassy, Helsinki, Finland. Foreign Economic Trends and Their Implications for the U.S.: Finland. Released by U.S. Department of Commerce. 78-015, February 1978, p. 2.
[4]Jernkontorets Annaler (Stockholm). V. 77, No. 4, p. 19.
[5]U.S. Embassy, Helsinki, Finland. State Department Airgram A-5, Feb. 3, 1978, p. 1.

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The Mineral Industry of France

By Roman V. Sondermayer[1]

The mineral industry of France produced only moderate amounts of most crude materials domestically, but remained a significant processor of substantial quantities of certain imported crude mineral commodities during 1977. The mineral processing sector overall was of greater economic significance to France as a whole than was mining; however, the value of extracted minerals was significant to certain local areas in terms of their economic well-being and the employment provided.

The most prominent minerals and metals produced in France during 1977, with production expressed in approximate percentages of the world total, were as follows: Arsenic, 20%; diatomite, 12%; gypsum, 9.9%; fluorspar, 8%; uranium, 7%; potash, 6%; bromine, 5%; lead metal, 5%; iron ore (gross weight), 4%; pig iron, 4%; aluminum, steel, and zinc metal, each 3%; and bauxite and iron ore (iron content), each 2%.

Principal events in the mineral industry included: The action of the Government to improve the use of copper scrap; the Government's plan to save the French steel industry; the reorganization of the Government-owned fertilizer industry; and closure of a petroleum refinery.

PRODUCTION

A generally downward trend in production reflected economic problems in the country. Table 1 shows the latest figures on French mineral production. Both private companies and the Government, through State-owned corporations, produce mineral commodities at home and abroad. The Bureau de Recherches Géologiques et Minières (BRGM) was an important instrument of the Government in securing raw materials for the domestic economy by exploration and ventures abroad.

Table 1.—France: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Aluminum:			
Bauxite, gross weight ---- thousand tons	2,563	2,330	2,059
Alumina ---- do	1,250	1,184	1,242
Metal:			
Primary ---- do	383	385	400
Secondary ---- do	107	133	146
Antimony metal, smelter production	2,727	4,500	4,562
Arsenic, white	4,163	[e r]4,000	[e]4,000
Bismuth:			
Ore and concentrate, metal content ---- kilograms	73,000	[e]80,000	[e]80,000
Metal ---- do	56,000	63,000	52,000
Cadmium metal	455	532	790
Cobalt metal	702	725	742

See footnotes at end of table.

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Table 1.—France: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS —Continued			
Copper:			
Mine output, metal content	500	500	300
Metal:			
Blister (secondary)	2,803	2,200	5,300
Refined:			
Primary	19,496	19,295	19,329
Secondary	r20,130	20,032	19,902
Total	r39,626	39,327	39,231
Gold:			
Mine output, metal content troy ounces	50,026	61,022	50,444
Metal[e] do	50,000	61,000	50,000
Iron and steel::			
Iron ore and concentrate:			
Gross weight thousand tons	49,647	45,181	36,630
Metal content do	15,309	13,792	11,050
Pig iron do	17,494	18,657	17,884
Ferroalloys:			
Blast furnace: Spiegeleisen and ferromanganese do	427	367	373
Electric furnace:			
Ferromanganese do	12	12	21
Ferrosilicon do	242	237	241
Ferrochrome do	100	101	104
Other do	85	98	96
Total do	439	448	462
Steel:			
Ingots and castings do	21,530	23,221	22,094
Semimanufactures do	17,558	19,459	20,196
Lead:			
Mine output, metal content	22,300	28,000	31,480
Metal, refined:			
Primary	r101,600	118,406	126,200
Secondary	15,364	12,995	11,398
Antimonial lead (lead content)	33,830	40,999	45,717
Total	r150,794	172,400	183,315
Magnesium, metal including secondary	7,532	8,006	8,685
Nickel, metal content of metallurgical products (pure nickel, ferronickel, and nickel oxide)	10,857	12,313	10,279
Silicon	34,970	41,000	42,580
Silver:			
Mine output, metal content thousand troy ounces	1,502	2,806	3,004
Metal (content of final smelter products) do	3,446	3,677	7,060
Tin concentrate, metal content	49	--	--
Tungsten concentrate, metal content	619	798	824
Uranium:			
Mine output, metal content	1,854	2,111	2,236
Chemical concentrate, U_3O_8 equivalent	r1,731	1,871	2,097
Zinc:			
Mine output, metal content	13,810	34,700	41,828
Metal, including secondary:			
Slab	181,130	233,500	238,270
Dust	8,770	7,460	9,790
NONMETALS			
Barite	92,000	150,000	220,000
Bromine, elemental	16,770	15,180	15,570
Cement, hydraulic thousand tons	29,588	29,394	28,830
Clays:			
Bentonite[1]	20,299	e20,000	e20,000
Brick and tile clay thousand tons	8,405	e8,000	e8,000
Ceramic and pottery clay do	695	e700	e700
Kaolin and kaolinite clay, crude	568,794	e r600,000	e600,000
Kyanite and andalusite	9,708	e10,000	e10,000
Refractory clay, unspecified thousand tons	962	e900	e900
Diatomite	188,075	e200,000	e200,000
Feldspar:			
Crude	199,000	188,000	192,000
Marketable[2]	192,001	e r200,000	e200,000
Fertilizer materials:			
Crude (natural):			
Phosphatic chalk	18,230	28,250	19,340
Potash:			
Gross weight thousand tons	12,235	10,272	10,593
K_2O equivalent do	2,085	1,738	1,719
K_2O equivalent (marketable) do	1,920	1,600	1,580

See footnotes at end of table.

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Table 1.—France: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
NONMETALS —Continued				
Fertilizer materials —Continued				
Manufactured:				
Nitrogenous, nitrogen content	thousand tons	[r]1,628	1,469	[e]1,400
Superphosphate, gross weight	do.	913	814	875
Thomas slag	do.	2,164	2,298	1,990
Other	do.	1,433	1,750	2,065
Potassic	do.	1,918	1,600	[e]1,600
Mixed, gross weight	do.	6,708	6,342	7,400
Ammonia (N content)	do.	1,941	1,781	NA
Fluorspar:				
Crude		730,000	675,000	630,000
Marketable[e]		[r]318,000	354,000	283,000
Gypsum and anhydrite, crude	thousand tons	6,903	[e] [r]6,900	[e]6,900
Lime, hydrated and quicklime, including dead-burned dolomite	do.	4,438	4,648	[e]4,459
Mica[e]		4,000	4,000	4,000
Pigments, mineral, natural: Iron oxides		12,702	[e]13,000	[e]13,000
Pozzolana and lapilli		694,000	638,000	702,000
Quartz and glass sand:				
Quartz[3]		532,107	[e] [r]500,000	[e]500,000
Glass sand	thousand tons	5,342	[e]5,000	[e]5,000
Salt:				
Rock salt	do.	180	280	287
Brine salt	do.	986	1,067	1,016
Marine salt	do.	1,127	1,431	557
Salt in solution	do.	3,054	3,300	3,490
Total	do.	5,347	6,078	5,350
Stone, sand and gravel:				
Building stone:				
Granite and similar stone	do.	788	NA	NA
Limestone	do.	809	NA	NA
Marble	do.	219	NA	NA
Crushed limestone and granite	do.	84	NA	NA
Other	do.	9,815	NA	NA
Dolomite:				
For agriculture		403,315	NA	NA
Crude for calcining		438,564	NA	NA
Other		225,036	NA	NA
Total		1,066,915	NA	NA
Limestone, agricultural and industrial:				
For agriculture	thousand tons	493	NA	NA
For iron and steel industry	do.	3,027	NA	NA
For lime and cement	do.	27,282	NA	NA
For sugar mills	do.	929	NA	NA
Total	do.	31,731	NA	NA
Roadbuilding, foundation and ballast stone (other than alluvial sand and gravel):				
Ballast	do.	119,320	NA	NA
Foundation material	do.	9,361	NA	NA
Ground rock for road filler	do.	314	NA	NA
Paving block and curbing	do.	111	NA	NA
Slate:				
Roof	do.	109	NA	NA
Other	do.	39	NA	NA
Other stone:				
Beach pebble	do.	164	NA	NA
Marl	do.	275	NA	NA
Mine fill	do.	8,215	NA	NA
Sand and gravel:				
Industrial sand:				
Foundry	do.	1,161	NA	NA
Miscellaneous	do.	733	NA	NA
Other sand and gravel (alluvial)	do.	252,518	232,000	226,000
Sulfur byproduct:				
From natural gas	do.	1,792	1,737	1,911
From petroleum	do.	93	88	89
From unspecified sources	do.	109	143	160
Total	do.	1,994	1,968	2,160
Talc:				
Crude		285,000	246,800	299,500
Powder		241,130	255,800	286,500

See footnotes at end of table.

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Table 1.—France: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS				
Asphaltic material[4]		96,770	94,180	82,270
Carbon black[e]		170,000	170,000	170,000
Coal:				
Anthracite	thousand tons	5,357	4,811	4,188
Bituminous	do.	17,067	17,068	17,087
Lignite	do.	3,186	3,188	3,080
Total	do.	25,610	25,067	24,355
Briquets	do.	2,795	2,516	2,222
Coke, metallurgical	do.	11,445	11,312	10,770
Gas, natural:				
Gross	million cubic feet	374,934	369,354	393,368
Marketed	do.	259,844	250,450	271,745
Natural gas liquids:				
Natural gasoline and condensate	thousand 42-gallon barrels	4,258	3,956	4,215
Propane	do.	1,645	1,608	1,717
Butane	do.	1,844	1,781	2,008
Total	do.	7,747	7,345	7,940
Peat	thousand tons	161	e r160	e160
Petroleum:				
Crude	thousand 42-gallon barrels	7,491	7,710	7,557
Refinery products:				
Gasoline:				
Aviation	do.	318	335	258
Motor	do.	138,125	152,527	149,728
Jet fuel	do.	28,130	28,099	29,361
Kerosine	do.	282	866	770
Distillate fuel oil	do.	273,384	309,401	303,920
Residual fuel oil	do.	220,486	243,617	240,783
Lubricants	do.	7,582	8,909	9,364
Other:				
Liquefied petroleum gas	do.	32,180	33,809	21,702
Bitumen	do.	21,040	20,825	20,268
Unspecified	do.	26,881	50,016	44,661
Refinery fuel and losses	do.	60,627	53,793	71,445
Total	do.	809,035	902,197	892,260

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]Includes smectic clay.

[2]Consists of material for the ceramic and glass industries and reportedly contains pegmatite.

[3]Data include quantity for glass industry as well as for ceramic use.

[4]Excludes bituminous material.

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TRADE

Tables 2 and 3 show details on the foreign trade of France. Mineral fuels remained the most expensive import items among the crude materials.

France had a positive minerals trade balance with the United States. Products of the iron and steel industry, radioactive materials, and petroleum products were the major U.S. imports from France. Coal, copper, aluminum, phosphates, and diamond were the principal commodities exported to France from the United States. Table 4 shows details of trade between the United States and France.

Table 2.—France: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Bauxite	46,005	32,307	Switzerland 24,183; Poland 2,029.
Oxide and hydroxide[1]	385,024	330,127	Netherlands 127,404; Spain 51,462; Canada 42,166.
Metal including alloys:			
Scrap	22,294	30,605	Italy 12,712; West Germany 10,340; Belgium-Luxembourg 5,026.
Unwrought	163,850	149,193	Belgium-Luxembourg 34,987; Italy 34,388; West Germany 25,067.
Semimanufactures	130,798	163,923	West Germany 50,313; Italy 12,309; United Kingdom 12,198.
Antimony, including metal scrap	386	157	West Germany 19.
Arsenic (anhydride)	8,940	5,759	Switzerland 719; United States 575.
Beryllium value, thousands[2]	$118	$27	United States $25.
Bismuth metal, all forms	107	107	Italy 84.
Cadmium	226	353	Belgium-Luxembourg 211; United States 88.
Chromium:			
Chromite	368	396	NA.
Oxide and hydroxide	127	174	West Germany 45.
Metal	269	712	West Germany 224; Italy 102; Japan 101.
Cobalt	461	943	West Germany 195; United States 162; U.S.S.R. 160.
Columbium (niobium) metal, all forms value, thousands[2]	$28	$60	NA.
Copper:			
Matte	397	551	West Germany 191; Italy 158; Spain 88.
Metal including alloys:			
Scrap	55,784	100,508	West Germany 36,801; Belgium-Luxembourg 36,014; Italy 19,810.
Blister and other unrefined	2,183	4,439	Belgium-Luxembourg 4,360.
Refined	881	8,708	West Germany 3,433; Italy 3,012; Belgium-Luxembourg 1,480.
Semimanufactures	79,176	98,107	West Germany 39,780; Netherlands 9,244; Belgium-Luxembourg 9,202.
Gallium[3] value, thousands[2]	$5,055	$5,356	Switzerland $5,292.
Gold:			
Ashes and sweepings kilograms	5,863	1,901	Switzerland 1,486.
Metal:			
For domestic use thousand troy ounces	107	120	West Germany 15; Netherlands 11; Belgium-Luxembourg 10.
Temporary imports do.	3,439	2,739	Switzerland 2,278.
Iron and steel:			
Iron ore thousand tons	16,016	15,854	Belgium-Luxembourg 13,036; West Germany 2,813.
Metal:			
Scrap do.	2,810	3,421	Italy 2,798; Belgium-Luxembourg 210.
Pig iron including spiegeleisen[4] do.	221	227	Italy 115; Belgium-Luxembourg 55; West Germany 35.
Ferroalloys do.	429	484	West Germany 118; Italy 95; Belgium-Luxembourg 59.
Shot and powder do.	31	32	West Germany 16; Italy 6; Spain 2.
Steel, primary forms, including coil do.	1,414	1,348	Italy 685; United States 204; Belgium-Luxembourg 144.

See footnotes at end of table.

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Table 2.—France: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Iron and steel —Continued			
Metal —Continued			
Semimanufactures:			
Bars, rods, angles, shapes, sections thousand tons	2,709	2,353	West Germany 484; Belgium-Luxembourg 343; United States 236.
Universals, plates, sheets do	2,670	2,826	West Germany 693; Italy 496; United States 185.
Hoop and strip do	383	416	West Germany 128; Italy 59; Belgium-Luxembourg 58.
Rails and accessories do	318	326	Morocco 47; Iran 46; Italy 44.
Wire do	114	154	West Germany 41; United States 37; Belgium-Luxembourg 11.
Tubes, pipes, fittings do	1,218	1,319	U.S.S.R. 281; West Germany 96; Iran 88.
Castings and forgings, rough do	81	85	Belgium-Luxembourg 27; West Germany 21; United Kingdom 5.
Lead:			
Ore	7,513	64	NA.
Oxide	9,134	12,290	Netherlands 3,000; Italy 1,896; Czechoslovakia 1,583; West Germany 1,398; Romania 1,330.
Metal including alloys:			
Scrap	5,139	15,055	West Germany 6,185; Italy 5,850; Netherlands 2,269.
Unwrought	21,176	32,845	Belgium-Luxembourg 14,779; West Germany 6,655; Switzerland 4,064.
Semimanufactures	1,525	1,735	Belgium-Luxembourg 289; Netherlands 271; Italy 238.
Magnesium metal including alloys, all forms	2,228	3,843	West Germany 1,729; Netherlands 660.
Manganese:			
Ore	4,494	9,224	Portugal 3,040; Spain 2,435; Italy 1,444.
Oxide	963	2,903	NA.
Metal including alloys, all forms	3,832	3,308	West Germany 1,146; Sweden 721; Italy 600.
Mercury 76-pound flasks	58	1,131	Morocco 551.
Molybdenum:			
Ore	NA	10	NA.
Oxide	48	273	Italy 207; West Germany 50.
Metal including alloys, all forms	87	145	Netherlands 65; West Germany 19; Italy 18.
Nickel:			
Matte, speiss, etc	NA	402	Finland 400.
Oxide	486	690	Italy 230; United States 90; Spain 79.
Metal including alloys:			
Scrap	1,744	2,746	West Germany 904; United Kingdom 444; Italy 358.
Ingots	5,235	4,469	West Germany 1,774; United Kingdom 512; Belgium-Luxembourg 502.
Semimanufactures	5,258	6,576	Belgium-Luxembourg 1,360; West Germany 996; Spain 684.
Platinum-group metals including alloys thousand troy ounces	186	219	Spain 36; United States 36; Switzerland 25.
Selenium	7	61	Japan 38.
Silver:			
Metal including alloys thousand troy ounces	18,874	15,911	Romania 229; West Germany 181; Belgium-Luxembourg 74.
Ashes and sweepings do	4,702	4,974	Spain 3,427; United Kingdom 614.
Tantalum metal, all forms value, thousands[3]	$109	$570	West Germany $387.
Thorium oxide	276	389	Hong Kong 229.
Tin:			
Ore	81	54	All to United Kingdom.
Oxide	43	27	West Germany 24.
Metal including alloys:			
Scrap	479	538	Netherlands 260; United Kingdom 171.
Ingots	483	235	Italy 124; Algeria 34.
Semimanufactures	175	264	Italy 34; Belgium-Luxembourg 31; West Germany 24.

See footnotes at end of table.

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Table 2.—France: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Titanium:			
Ore	515	425	Algeria 304.
Oxide	8,979	12,700	United States 1,931; West Germany 1,921.
Metal, all forms	432	532	United Kingdom 237; West Germany 112.
Tungsten:			
Ore	1,398	1,322	West Germany 1,242.
Oxide	1	44	Austria 18; West Germany 13.
Metal, all forms	278	372	Belgium-Luxembourg 73; West Germany 61.
Zinc:			
Ore	17,361	19,990	Italy 19,930.
Matte	1,100	2,716	Italy 976; West Germany 760; Belgium-Luxembourg 412.
Metal including alloys:			
Scrap	2,847	2,895	Belgium-Luxembourg 2,027; Italy 491.
Dust (blue powder)	2,739	1,693	Poland 600; West Germany 535.
Slab and ingot	18,089	34,218	West Germany 8,538; Portugal 3,064; Sweden 2,141.
Semimanufactures	25,693	27,380	West Germany 8,528; Belgium-Luxembourg 8,509; Denmark 3,078.
Zirconium:			
Ore	798	999	Canada 480; Italy 437.
Oxide	126	234	West Germany 87; Italy 78; Spain 25.
Metal, including nuclear grade	184	319	United States 119; Sweden 100.
Other:			
Ores and concentrates	135	95	NA.
Ash and residue from nonferrous metals:			
Aluminum	6,740	6,699	Italy 5,029; West Germany 1,329.
Copper	8,758	10,691	Belgium-Luxembourg 6,866; West Germany 2,961.
Lead	4,172	6,833	Belgium-Luxembourg 5,788; West Germany 862.
Nickel	452	1,114	West Germany 403; East Germany 340; Belgium-Luxembourg 160.
Zinc	9,632	34,329	Belgium-Luxembourg 22,881; West Germany 5,546.
Other	19,629	22,658	Sweden 10,879; Belgium-Luxembourg 8,882.
Ashes, sweepings, and other residue of platinum, silver, and other precious metals	146	155	Spain 107; United Kingdom 19; West Germany 15.
Slag and ash, n.e.s	84,643	173,975	West Germany 158,590.
Metal including alloys, all forms[5]	377	302	Yugoslavia 120; West Germany 108.
NONMETALS			
Abrasives, natural:			
Pumice, emery, other	341	636	Poland 114.
Dust and powder of precious and semiprecious stones value, thousands[2]	$549	$496	Switzerland $231; United Kingdom $90; United States $81.
Grinding and polishing wheels and stones	4,079	3,540	West Germany 628; Italy 398; Belgium-Luxembourg 387.
Asbestos, crude	2,050	2,314	Pakistan 1,113; Tunisia 409.
Barite and witherite	22,552	58,560	United States 23,992; West Germany 16,681.
Borates, natural	503	920	Belgium-Luxembourg 721.
Cement thousand tons	2,103	1,901	West Germany 253; Venezuela 221; United States 145.
Chalk	427,554	497,620	West Germany 207,942; Belgium-Luxembourg 90,628; Netherlands 54,234.
Clays and clay products (including all refractory brick):			
Crude:			
Kaolin	110,954	104,472	West Germany 51,603; Italy 28,261.
Bentonite	7,182	5,722	Gabon 2,011; Nigeria 1,189; Tunisia 954.
Refractory	2,338	4,463	West Germany 4,246.
Other	247,584	244,499	Italy 134,426; West Germany 45,113; Belgium-Luxembourg 26,648.
Products, refractory (including nonclay brick)	478,463	499,266	West Germany 184,434; Belgium-Luxembourg 116,296.

See footnotes at end of table.

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Table 2.—France: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Corundum:			
Natural, including emery (also included under "Abrasives")	396	334	Poland 114.
Artificial	17,345	18,210	Austria 3,172; West Germany 2,783; Italy 2,698.
Cryolite and chiolite, natural	445	--	
Diamond:			
Industrial, excluding powder value, thousands[3]	$1,222	$1,446	Ireland $775; Belgium-Luxembourg $437.
Gem, unset do.	$17,808	$16,431	Switzerland $6,564; Notherlands $3,123; Belgium-Luxembourg $2,717.
Diatomite	18,186	17,577	West Germany 7,951; Belgium-Luxembourg 2,646.
Feldspar	38,362	37,528	Belgium-Luxembourg 19,744; Spain 9,774; West Germany 5,382.
Fertilizer materials:			
Crude:			
Nitrogenous (natural sodium nitrates)	2	24	NA.
Phosphate rock	3,704	1,952	West Germany 1,384.
Potassic salts	11,994	12,869	Belgium-Luxembourg 10,797.
Organic	23,036	25,039	Switzerland 16,717; Belgium-Luxembourg 3,164.
Manufactured:			
Nitrogenous thousand tons	575	476	Belgium-Luxembourg 121; West Germany 61; Morocco 43.
Phosphatic:			
Basic slag do.	198	187	Switzerland 102; Austria 44; Italy 31.
Other do.	100	44	Poland 12; Belgium-Luxembourg 6.
Potassic do.	742	578	Belgium-Luxembourg 223; Italy 94; West Germany 73.
Ammonia, anhydrous do.	259	210	West Germany 87; Spain 44.
Flint (pebbles)	89,548	85,220	West Germany 23,522; Belgium-Luxembourg 20,333; United Kingdom 11,062.
Fluorspar	109,337	92,135	West Germany 56,886.
Graphite	589	1,029	West Germany 548; Spain 120.
Gypsum and anhydrite, including plasters thousand tons	1,068	932	Belgium-Luxembourg 435; West Germany 182; Netherlands 152.
Iodine	61	9	NA.
Lime	236,133	301,065	Belgium-Luxembourg 141,818; West Germany 128,796.
Magnesite, including calcined	516	461	NA.
Mica	2,746	3,142	United Kingdom 1,292; West Germany 582; Belgium-Luxembourg 445.
Pigments, mineral, including iron oxides	2,064	2,707	Algeria 497; West Germany 326.
Pozzolans, Santorin earth, etc	2,081	1,317	NA.
Precious and semiprecious stones, except diamond[6] value, thousands[3]	$22,886	$21,196	Switzerland $11,151; United States $2,146; West Germany $1,732.
Pyrite, gross weight	75	22	NA.
Salt	106,899	128,885	West Germany 96,413; Belgium-Luxembourg 20,032.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	355,474	442,111	Guinea 88,052; Brazil 70,202; Yugoslavia 57,405.
Caustic potash and sodic and potassic peroxides	6,568	6,695	United Kingdom 1,670.
Stone, sand and gravel:[7]			
Building stone:			
Crude and partly worked, n.e.s	103,160	100,598	Belgium-Luxembourg 63,986; Switzerland 12,180; West Germany 11,111.
Worked:			
Slate, including crude	39,741	80,779	Notherlands 24,411; West Germany 18,458; Belgium-Luxembourg 10,526.
Not specified	13,114	14,937	Belgium-Luxembourg 7,980; West Germany 3,425.
Dolomite, chiefly refractory grade	44,863	37,481	Ivory Coast 9,790; Belgium-Luxembourg 8,737; West Germany 6,688.
Gravel and crushed stone thousand tons	11,921	10,292	West Germany 7,572; Switzerland 1,425.
Limestone (except dimension)	174,589	152,558	West Germany 82,454; Belgium-Luxembourg 67,924.
Quartz and quartzite	8,733	2,431	United Kingdom 142.

See footnotes at end of table.

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Table 2.—France: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Stone, sand and gravel[7] —Continued			
Sand excluding metal bearing thousand tons	3,522	3,858	West Germany 2,030; Switzerland 886; Italy 685.
Sulfur, elemental do	539	742	United Kingdom 288; Netherlands 81; Italy 79.
Talc and steatite	63,397	59,426	West Germany 16,532; United Kingdom 11,131; Spain 8,126.
Other:			
Crude	263,020	266,613	Switzerland 247,791.
Slag, dross, and similar waste, not metal bearing, from iron and steel manufacture thousand tons	1,021	1,162	West Germany 601; Belgium-Luxembourg 530.
Oxides and hydroxides of magnesium, strontium, barium	7,253	9,912	U.S.S.R. 3,741; West Germany 1,716.
Fluorine	23	--	
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	27,082	44,405	Belgium-Luxembourg 35,968; United Kingdom 8,193.
Carbon black	37,255	44,364	West Germany 14,926; Italy 7,273; Spain 6,822.
Coal and briquets:			
Bituminous coal	552,420	594,129	West Germany 347,180; Belgium-Luxembourg 127,649.
Briquets of bituminous coal	85,354	50,047	United Kingdom 42,379; Italy 3,828.
Lignite	14,999	19,007	All to Spain.
Coke thousand tons	719	939	West Germany 191; Belgium-Luxembourg 143.
Gas, natural million cubic feet	5,372	6,040	Belgium-Luxembourg 3,019; Switzerland 2,886.
Hydrogen, helium, rare gases	935	2,116	Belgium-Luxembourg 1,451.
Peat, including briquets	NA	1,790	NA.
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	15,785	23,613	Netherlands 6,297; Switzerland 5,277; United Kingdom 4,464.
Kerosine and jet fuel do	7,270	6,641	Switzerland 2,407; West Germany 1,196.
Distillate fuel oil do	26,841	29,228	Switzerland 12,548; West Germany 11,981.
Residual fuel oil do	21,345	20,566	Italy 7,326; West Germany 4,448; Sweden 2,039.
Lubricants do	2,771	3,220	Belgium-Luxembourg 612; United Kingdom 443; West Germany 354.
Other:			
Liquefied petroleum gas do	5,881	8,236	Spain 3,724; Portugal 1,183.
Bitumen, petroleum coke, other residues do	2,479	2,006	West Germany 994; Switzerland 630; Belgium-Luxembourg 218.
Coal-, petroleum-, or gas-derived crude chemicals	193,746	204,857	West Germany 104,079; United Kingdom 47,083.

NA Not available.
[1]Excludes artifical corundum.
[2]Based on an exchange rate of 4.80 francs = US$1.00. in 1975 and 4.7796 francs = US$1.00 in 1976.
[3]Includes indium and thallium.
[4]Includes cast iron and shot, grit, powder, and sponge of iron and steel.
[5]Includes alkali, alkaline-earth, and rare-earth metals except sodium and mercury.
[6]Includes synthetic and reconstituted stone.
[7]Excludes flint and industrial limestone.

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Table 3.—France: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite	1,456,000	2,269,601	Guinea 1,716,778; Australia 382,930.
Oxide and hydroxide[1]	15,708	24,501	West Germany 14,074; Netherlands 4,067; United States 3,419.
Metal including alloys:			
Scrap	25,190	31,729	Belgium-Luxembourg 12,369; West Germany 10,093.
Unwrought	217,903	251,404	West Germany 67,132; Netherlands 53,517; Greece 30,515.
Semimanufactures	107,442	175,419	West Germany 64,341; Belgium-Luxembourg 47,411; Netherlands 21,149.
Antimony:			
Ore and concentrate	5,045	10,829	Republic of South Africa 2,825; Bolivia 2,436; Thailand 2,180.
Metal, all forms	527	563	Belgium-Luxembourg 259; Spain 130.
Arsenic, anhydride and acid	2	42	NA.
Beryllium metal, all forms value, thousands[2]	$406	$529	United States $484.
Bismuth	640	747	Bolivia 286; Belgium-Luxembourg 219.
Cadmium	694	559	Belgium-Luxembourg 170; Japan 122; Netherlands 94.
Chromium:			
Ore	354,109	345,481	Madagascar 105,832; U.S.S.R. 98,614; Republic of South Africa 68,387.
Oxide and hydroxide	2,397	5,695	West Germany 1,591; United Kingdom 1,467; Italy 1,464.
Metal, all forms	65	69	Japan 31; United Kingdom 24.
Cobalt:			
Ore	9,158	8,679	All from Morocco.
Oxide and hydroxide	170	198	Belgium-Luxembourg 183.
Metal, all forms	681	796	Zaire 377; Belgium-Luxembourg 126.
Columbium and tantalum:			
Ores[3]	1,241	196	All from Canada.
Metals, all forms:			
Columbium value, thousands[2]	$187	$155	West Germany $69.
Tantalum	23	24	West Germany 11; United States 8.
Copper:			
Ore and concentrate	879	31	NA.
Matte	872	1,179	United Kingdom 833; West Germany 202.
Metal including alloys:			
Scrap	14,228	16,762	United States 3,417; West Germany 2,849; Belgium-Luxembourg 2,152.
Blister and other unrefined	26,777	23,894	Zaire 10,835; Belgium-Luxembourg 4,807; Chile 4,518.
Refined	2,816	366,734	Belgium-Luxembourg 92,396; Chile 56,376; Zambia 47,980.
Semimanufactures	92,400	153,180	Belgium-Luxembourg 72,857; West Germany 36,027; Italy 19,303.
Germanium, gallium, etc. value, thousands[2]	$616	$1,032	Belgium-Luxembourg $661; West Germany $207.
Gold:			
Ashes and sweepings kilograms	6,213	319	Switzerland 225; Spain 66.
Metal:			
For domestic use thousand troy ounces	313	418	Netherlands 225; West Germany 129.
Temporary imports do	3,506	2,797	Switzerland 2,186; Republic of South Africa 289.
Iron and steel:			
Ore and concentrate, except roasted pyrite thousand tons	13,169	14,057	Brazil 4,206; Mauritania 2,245; Liberia 1,886.
Roasted pyrite	107,093	81,402	Italy 41,274; West Germany 24,546; Spain 15,578.
Metal:			
Scrap	278,066	280,677	Belgium-Luxembourg 139,603; West Germany 78,137; United Kingdom 44,345.
Pig iron, spiegeleisen, other[4] thousand tons	329	457	West Germany 344; Canada 24.
Ferroalloys do	204	192	New Caledonia 94; West Germany 19; Belgium-Luxembourg 16.
Steel, primary forms do	1,250	2,195	Belgium-Luxembourg 1,157; West Germany 688; Italy 133.

See footnotes at end of table.

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Table 3.—France: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Iron and steel —Continued			
Metal —Continued			
Semimanufactures:			
Bars, rods, sections[5] thousand tons	2,035	2,545	Belgium-Luxembourg 892; West Germany 857; Italy 391.
Universals, plates, sheets do	2,594	2,958	Belgium-Luxembourg 1,361; West Germany 704; Japan 142.
Hoop and strip do	266	430	Belgium-Luxembourg 220; West Germany 128; Italy 35.
Rails and accessories do	57	35	Belgium-Luxembourg 16; United Kingdom 14; West Germany 5.
Wire do	115	172	Belgium-Luxembourg 69; West Germany 55; Netherlands 16.
Tubes, pipes, fittings do	401	540	West Germany 185; Italy 133; Spain 60.
Castings and forgings, rough do	31	42	West Germany 22; Italy 5; Switzerland 5.
Lead:			
Ore and concentrate	129,803	93,452	Canada 28,532; Ireland 13,200; Morocco 12,514.
Oxide	1,475	2,085	Belgium-Luxembourg 1,111; West Germany 420; East Germany 378.
Metal including alloys:			
Scrap	12,599	6,611	Belgium-Luxembourg 3,397; Netherlands 1,307; West Germany 1,030.
Unwrought	57,798	56,388	Belgium-Luxembourg 21,752; United Kingdom 7,084.
Semimanufactures	734	631	Belgium-Luxembourg 398.
Magnesium metal including alloys:			
Scrap	271	373	Italy 216.
Unwrought	2,665	2,612	Norway 1,450.
Semimanufactures	113	193	United Kingdom 93; West Germany 42; United States 26.
Manganese:			
Ore and concentrate thousand tons	1,158	1,015	Republic of South Africa 502; Gabon 429.
Oxide	4,155	613	Belgium-Luxembourg 424; West Germany 93.
Metal, all forms	932	1,110	Republic of South Africa 604; Japan 380.
Mercury 76-pound flasks	7,774	6,411	Italy 2,495; Algeria 1,770; Spain 754.
Molybdenum:			
Ore and concentrate	7,138	7,633	Canada 4,478; United States 1,897; Netherlands 877.
Oxide	136	75	Netherlands 64.
Metal, all forms	213	168	Austria 51; United States 23.
Nickel:			
Matte	15,202	16,731	New Caledonia 15,140.
Oxide and hydroxide	212	190	Canada 146; Belgium-Luxembourg 37.
Metal including alloys:			
Scrap	1,546	1,452	Belgium-Luxembourg 311; West Germany 271; Spain 223.
Unwrought	17,030	16,043	United Kingdom 3,968; U.S.S.R. 2,922; Canada 2,470.
Semimanufactures (including anodes)	6,674	6,306	West Germany 2,036; Belgium-Luxembourg 1,319; United Kingdom 1,106.
Platinum-group metals:			
Ashes and sweepings kilograms	1,232	4,721	Switzerland 2,739; Netherlands 479.
Metals troy ounces	377,739	372,016	United Kingdom 131,271; Republic of South Africa 47,422; West Germany 37,841.
Selenium	35	36	Japan 20; Belgium-Luxembourg 5.
Silver:			
Ashes and sweepings kilograms	19,783	26,177	Switzerland 11,295; Spain 5,545; Netherlands 3,258.
Metal, all forms thousand troy ounces	35,076	47,986	United Kingdom 21,187; India 5,916.
Thorium ore (monazite)	3,961	4,414	Australia 3,985.
Tin:			
Oxide	193	222	Italy 153; West Germany 62.
Metal including alloys:			
Scrap	310	189	Italy 126; Switzerland 52.
Ingots	10,143	10,832	Malaysia 4,990; Indonesia 1,919; Belgium-Luxembourg 806.

See footnotes at end of table.

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Table 3.—France: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Tin —Continued			
Metal including alloys —Continued			
Semimanufactures	167	119	West Germany 68; Netherlands 24.
Titanium:			
Ore	117,414	194,001	Australia 193,218.
Oxide	22,393	26,756	West Germany 11,584; Belgium-Luxembourg 5,702; Italy 3,648.
Metal, all forms	2,415	1,154	U.S.S.R. 463; United Kingdom 336; United States 170.
Tungsten:			
Ore	2,172	2,377	People's Republic of China 518; Republic of Korea 480.
Trioxide	6	65	All from West Germany.
Metal, all forms	119	186	West Germany 80; Switzerland 50.
Uranium:			
Ore	1,882	1,789	All from Nigeria.
Metal including alloys kilograms	1,557,564	1,923,731	Belgium-Luxembourg 552,234; West Germany 475,694; Spain 244,499.
Zinc:			
Ore and concentrate	389,779	463,706	Peru 105,803; Canada 102,085; Sweden 44,312.
Oxide	4,211	3,742	West Germany 951; Belgium-Luxembourg 750; U.S.S.R. 572.
Metal including alloys:			
Scrap	13,276	12,174	Belgium-Luxembourg 5,197; Italy 1,809; United Kingdom 1,403.
Blue powder	2,538	3,373	Belgium-Luxembourg 3,077.
Unwrought	74,914	34,218	United States 12,135; West Germany 8,538; Portugal 3,064.
Semimanufactures	2,222	27,380	West Germany 8,528; Belgium-Luxembourg 8,509; Denmark 3,078.
Zirconium:			
Ore	34,721	27,822	Australia 26,645.
Oxide[e]	581	1,345	United States 1,064; United Kingdom 222.
Metal	178	155	United States 140.
Other:			
Ores and concentrates	8,407	9,539	Guyana 7,051; Ireland 1,316.
Ash and residue containing nonferrous metals:			
Aluminum	9,838	7,076	Netherlands 3,176; Italy 1,755; West Germany 1,236.
Copper	1,660	1,823	Belgium-Luxembourg 1,548.
Lead	1,306	6,186	Italy 5,230.
Nickel	12	130	NA.
Zinc	1,116,044	20,745	West Germany 9,338; Belgium-Luxembourg 6,193.
Other	4,578	5,415	Italy 4,695.
Metals including alloys, all forms	253	133	West Germany 29.
NONMETALS			
Abrasives:			
Emery, natural corundum, etc	1,288	23,925	Turkey 18,639; Greece 3,120.
Pumice	15,067	5,473	Italy 2,686; West Germany 2,465.
Dust and powder of precious and semiprecious stones value, thousands[2]	$6,012	$9,188	United States $4,897; Republic of South Africa $2,468; United Kingdom $1,047.
Grinding and polishing wheels and stones	7,205	3,540	West Germany 628; Italy 398; Belgium-Luxembourg 387.
Asbestos	138,637	143,625	Canada 58,839; U.S.S.R. 47,169.
Barite and witherite	44,429	11,411	Morocco 5,485; West Germany 3,813; People's Republic of China 2,003.
Boron materials:			
Crude natural borates	111,273	131,893	Turkey 67,769; United States 60,182.
Oxide and acid	1,049	1,467	Italy 952; United States 483.
Bromine	673	997	Israel 791; United Kingdom 184.
Cement	31,399	76,672	Belgium-Luxembourg 38,829; Italy 26,834; West Germany 9,132.
Chalk	31,067	21,899	West Germany 15,659; Belgium-Luxembourg 6,097.
Clays and clay products:			
Crude:			
Kaolin, including calcined	278,500	288,500	United Kingdom 224,887; United States 32,427.
Bentonite	102,423	93,080	Italy 43,656; Greece 18,688; West Germany 15,837.
Clay and construction materials (bricks, etc.)	725,817	986,708	Italy 405,627; West Germany 327,808.
Cryolite and chiolite, natural	1,246	959	Denmark 838.

See footnotes at end of table.

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Table 3.—France: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Diamond:			
Industrial, except dust value, thousands[3]	$7,785	$6,520	Ireland $2,487; United Kingdom $874.
Gem, unset ——do——	$94,564	$113,218	Belgium-Luxembourg $42,805; Israel $22,461.
Diatomite	7,688	6,861	United States 3,283; West Germany 2,116; Spain 846.
Feldspar	8,669	10,806	West Germany 7,693; Spain 2,274.
Fertilizer materials:			
Crude:			
Nitrogenous (natural sodium nitrate)	9,199	3,852	Chile 3,782.
Phosphate rock thousand tons	3,452	4,070	Morocco 1,228; Togo 867; Senegal 531.
Manufactured:			
Nitrogenous ——do——	648	1,029	Belgium-Luxembourg 325; Netherlands 275; Romania 128.
Potassic ——do——	404	323	Belgium-Luxembourg 130; Congo 93; U.S.S.R. 38.
Phosphatic:			
Basic slag ——do——	508	319	Mainly from Belgium-Luxembourg.
Other ——do——	248	536	United States 139; Tunisia 113; Belgium-Luxembourg 93.
Ammonia	295,696	228,378	Belgium-Luxembourg 118,986; Netherlands 90,838.
Flint (pebbles)	884,161	1,190,058	United Kingdom 1,181,918.
Fluorspar	16,089	2,152	West Germany 1,218.
Graphite	6,564	5,890	Madagascar 1,531; People's Republic of China 1,005.
Gypsum and plasters	14,081	18,754	Spain 8,715; West Germany 6,708.
Iodine, crude	510	590	Japan 414; Chile 151.
Lime	152,143	149,414	Belgium-Luxembourg 76,461; West Germany 71,572.
Lithium and strontium minerals	r1,454	6,407	Republic of South Africa 1,071.
Magnesite, including calcined	74,591	72,633	Greece 18,827; Austria 10,734; Japan 8,950; Spain 8,289.
Mica	9,250	4,238	India 3,139.
Pigments:			
Earth pigments, including iron oxides	613	609	West Germany 161.
Earth, other (pozzolana, Santorin earth, etc.)	NA	679	All from Netherlands.
Precious and semiprecious stones, except diamond[7] value, thousands[3]	$52,292	$47,155	Switzerland $15,099; India $10,663.
Pyrite	52,374	30,991	Norway 23,932; Spain 3,986.
Salt	131,414	127,494	Belgium-Luxembourg 66,203; Netherlands 30,556.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	78,815	99,075	Belgium-Luxembourg 33,085; West Germany 28,986; Netherlands 16,779.
Caustic potash and sodic and potassic peroxides	400	487	West Germany 329.
Stone, sand and gravel:[8]			
Dimension stone:			
Crude and partly worked:			
Slate	4,502	6,327	United Kingdom 4,396; Spain 1,014.
Other	192,072	209,946	Republic of South Africa 62,806; Italy 60,777; Norway 29,222.
Worked:			
Slate	71,804	105,762	Spain 102,315.
Other	114,484	144,653	Italy 94,210; West Germany 38,699.
Dolomite, chiefly refractory grade	331,530	360,362	Belgium-Luxembourg 268,903; West Germany 84,595.
Gravel and crushed stone thousand tons	4,273	4,887	Belgium-Luxembourg 4,599.
Limestone	227,967	253,689	Belgium-Luxembourg 226,925; United Kingdom 26,764.
Quartz and quartzite	19,646	13,940	Italy 7,970; West Germany 1,822.
Sand, excluding metal bearing thousand tons	1,543	1,419	Belgium-Luxembourg 531; United Kingdom 295; Netherlands 251.
Sulfur, elemental, all grades	569,347	504,769	United States 360; Spain 667; West Germany 546.
Talc and steatite	6,909	8,392	Italy 4,054; Belgium-Luxembourg 1,718; Norway 1,320.
Other	106,364	135,992	West Germany 58,797; Greece 34,854; Republic of South Africa 29,112.

See footnotes at end of table.

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Table 3.—France: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	2,615	3,589	United States 810.
Carbon black	63,688	75,131	Netherlands 39,372; West Germany 18,020.
Coal and briquets:			
Bituminous coal thousand tons	17,282	18,752	Poland 5,735; West Germany 4,548; United States 3,131.
Briquets of bituminous coal do	59	46	West Germany 38.
Lignite and lignite briquets do	194	174	Mainly from West Germany.
Coke do	2,885	2,712	West Germany 2,278; Netherlands 333.
Gas, natural million cubic feet	366,599	535,731	Netherlands 411,668; Algeria 124,021.
Hydrogen and rare gases	18,841	21,251	West Germany 9,791; Belgium-Luxembourg 8,236; Netherlands 2,611.
Peat, including briquets thousand tons	81	97	West Germany 52; Netherlands 23; U.S.S.R. 18.
Petroleum:			
Crude thousand 42-gallon barrels	749,035	891,601	Saudi Arabia 316,139; Iraq 122,422; Iran 107,673.
Refinery products:			
Gasoline do	15,190	16,898	West Germany 4,684; Italy 3,976; Netherlands 1,538.
Kerosine do	961	621	Italy 209; Trinidad and Tobago 144; United Kingdom 100.
Distillate fuel oil do	14,472	21,612	West Germany 3,905; Romania 2,322; United Kingdom 1,982.
Residual fuel oil do	20,546	21,425	Netherlands 4,966; Belgium-Luxembourg 3,920; U.S.S.R. 3,067.
Lubricants do	500	762	United Kingdom 175; Italy 159; Netherlands 97.
Other:			
Liquefied petroleum gas do	2,777	3,101	U.S.S.R. 1,241; Algeria 410; United Kingdom 179.
Vaseline, waxes, petroleum coke, bitumen, mixtures of bitumen, etc do	3,873	4,039	United States 2,938; West Germany 438.
Mineral tar and coal-, petroleum-, or gas-derived crude chemicals	517,133	393,713	United States 215,715; Netherlands 46,518; Belgium-Luxembourg 43,570.

[r]Revised. NA Not available.
[1]Excludes artifical corundum.
[2]Based on an exchange rate of 4.80 francs=US$1.00 in 1975 and 4.7796 francs=US$1.00 in 1976.
[3]Includes vanadium ore.
[4]Includes cast iron and iron and steel sponge, powder, etc.
[5]Includes wire rod.
[6]Includes germanium oxides.
[7]Including synthetic and reconstituted stone.
[8]Excludes flint and industrial limestone.

Table 4.—France: Mineral trade with the United States, 1976[1]

Commodity	Exports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
METALS				
Aluminum metal including alloys	15,243	$18,915	13,903	$19,090
Copper metal including alloys	9,178	13,010	20,592	37,116
Iron and steel:				
Ore and concentrate	--	--	10,831	1,129
Metal:				
Scrap	--	--	3,162	306
Pig iron	19	20	--	--
Ferroalloys	119,286	47,845	189	300
Steel, primary forms	1,020	226	224	168
Semimanufactures:				
Bars and angles	212,323	60,058	435	1,014
Plates and sheets	376,256	109,021	2,355	2,575

See footnotes at end of table.

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Table 4.—France: Mineral trade with the United States, 1976[1] —Continued

Commodity	Exports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
METALS —Continued				
Iron and steel —Continued				
Metal —Continued				
Semimanufactures —Continued				
Hoop and strip	4,318	3,919	576	1,033
Rails	2,546	843	196	19
Wire	32,284	16,950	2	14
Tubes and pipes	13,202	9,992	--	--
Castings and forgings	473	570	1,212	5,636
Lead metal including alloys	20	27	43	79
Mercury	--	--	(2)	2
Molybdenum ore and concentrate	--	--	180	1,169
Nickel metal including alloys	385	2,272	1,088	11,270
Platinum-group metals and silver:				
Ores	2	259	1	333
Metals:				
Platinum-group	(2)	1,559	(2)	869
Silver metal including alloys	1	99	26	2,589
Radioactive and associated materials	10,161	195,628	516	70,301
Tin metal including alloys	NA	1	2	14
Zinc metal including alloys	9,453	7,475	199	107
Other nonferrous metals:				
Ores and concentrates, n.e.s	101	66	141	600
Metals:				
Base metals including alloys, n.e.s	1,940	5,483	622	6,504
Scrap	931	1,251	5,596	3,445
NONMETALS				
Abrasives, natural, including diamond	4,628	356	3,055	5,291
Cement	160,748	5,179	--	--
Clays and refractory materials	67	30	31,765	3,800
Diamond and precious stones:				
Industrial diamond	NA	32	--	--
Gem diamond and precious stones	1	5,510	47	16,275
Fertilizer materials:				
Crude, phosphatic	--	--	566,217	17,100
Manufactured, potash	14,515	1,491	--	--
Ammonia, anhydrous	8	497	--	--
Lime	48	32	--	--
Oxygen, nitrogen, rare gases	--	--	669	539
Quartz, mica, feldspar, etc	7,772	607	364	139
Salt, sodium chloride	314	30	--	--
Stone, sand and gravel:				
Dimension stone	293	131	--	--
Crushed and broken stone, sand and gravel	463	37	784	746
Sulfur and unroasted pyrites	--	--	20	3
Other, crude	54,156	3,196	1,488	220
MINERAL FUELS AND RELATED MATERIALS				
Asphalt, natural	--	--	1,167	180
Coal, all types	--	--	3,203,413	154,550
Coke	88,120	9,315	--	--
Gas, natural and manufactured	11,657	979	--	--
Petroleum:				
Crude and partly refined	124,696	12,543	--	--
Refinery products:				
Gasoline	31	4	--	--
Distillate fuel oil	1	(2)	--	--
Residual fuel oil	348,245	24,363	--	--
Lubricants	263	81	21,493	7,092
Petroleum jelly and mineral waxes	60	30	2,326	2,725
Petroleum coke, asphalt, etc	36	11	367,062	27,810
Total	XX	559,943	XX	402,152

NA Not available. XX Not applicable.
[1]Data may differ from those reported elsewhere in this chapter owing to a difference in source.
[2]Less than 1/2 unit.

Source: U.S. Department of Commerce, Bureau of the Census.

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COMMODITY REVIEW

METALS

Aluminum.—French bauxite production declined in relation to the output in 1976, because reserves of certain deposits were exhausted. Six companies, Aluminium Péchiney, Société Anonyme de Bauxite et Alumines de Provence (SABP), Alusuisse, Etablissement Rondani, La Société Pyrénéene des Matieres Premieres Industrielles, and Etablissement Saboulard, produced bauxite. By far the largest was Aluminium Péchiney, whose output accounted for 70% of the total. Péchiney continued underground exploration of the Bauxite deposit, Bouches-du-Rhône; and Alusuisse explored in Var and Hérault. Bauxite mines were located in southern France in the Departments of Var, Hérault, Bouches-du-Rhône, and Ariége as shown in the following tabulation, with 1977 production given as a percent of the total:

Department	Percent of total
Var	75.2
Hérault	14.7
Bouches-du-Rhône	9.8
Ariége	.3
Total	100.0

The following three alumina plants, owned and operated by Péchiney-Ugine-Kuhlmann (PUK), operated during 1977:

	Production, percent of total	Approximate capacity (thousand tons per year)
Bouches-du-Rhône:		
Gardane	60	745
La Barnasse	27	350
Gard:		
Salindres	13	240
Total	100	1,335

About one-third of French alumina was exported, of which 40% was to the Netherlands, where Péchiney has an aluminum smelter. During 1977, French alumina plants operated at about 90% of installed annual capacity.

Ten smelters, all owned by PUK, were in operation in 1977, as follows:

Region and location of aluminum smelter	Production (thousand tons)		Capacity Dec. 31, 1977 (thousand tons)[1]
	1976	1977	
Pyrénées-Atlantiques:			
Noguères	102	107	115
Hautes-Pyrénées:			
Lannemezan	52	53	57
Ariége:			
Auzat	32	33	31
Sabarat	23	24.5	24
Savoie:			
La Praz	4	4	4
La Saussaz	11	12	12
Saint-Jean-de-Maurienne	69	72	75
Venthon	28	29	28
Isère:			
Riopéroux	24	24.5	25
Hautes-Alpes:			
Largentière	40	40	39
Total	385	399	410

[1]Source: U.S. Bureau of Mines. Primary Aluminum Plants, Worldwide. Part 2, pp. 8-9.

Source: Annales des Mines, Paris. No. 9-10 (September-October 1978), p. 41.

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During 1977, PUK introduced new electrolytic cells that are more efficient, eliminate emissions of fluor, and improve working conditions without needing more area. Output per square meter of cell reportedly will be increased by 30%. The smelter at Saint-Jean-de-Maurienne was scheduled to be the first to install the new cells, which would increase annual capacity there to 92,000 tons, and later to 120,000 tons.

France was a net importer of aluminum metal. Imports contributed 39% of French supply and were essential to meet the country's aluminum demand. Domestic output accounted for about 75% of the aluminum consumption of France. Countries of the European Economic Community (EEC) supplied 52% of aluminum imports.

Antimony.—During 1977, BRGM continued exploration for antimony at Quimper (Finistère) and Lucette (Mayenne) and in Haute-Loire Department.

The French company, Société Nouvelle des Mines de la Lucette, operated a smelter and plant for production of oxides, sulfides, and other chemicals of antimony at Le Genest (Mayenne). Production was based on concentrates from Morocco.

Copper.—France remained dependent on imports of copper. Mine output was for all purposes nonexistent. Imported blister or anodes and domestic and imported scrap were used in domestic copper refineries. Only one, the 45,000-ton-per-year electrolytic plant located at Palais, Haute-Vienne, was of economic significance. The others were small units with annual production ranging between 27 and 550 tons of copper.

In 1977, consumption of primary copper was about 326,000 tons. To alleviate the economic burden of copper imports, the French Government, through a committee on plans for copper, started to encourage increased collection and expanded facilities for processing copper scrap. Major projects were to increase by 15,000 tons per year the quantity of scrap suitable for producing material similar to primary copper, to assist construction of four units for mechanical treatment of cable to recover 18,000 tons of copper per year, and systematic studies to find substitutes for copper.

Cobalt.—French production of cobalt metal increased slightly over that of 1976. Cobalt was produced from Moroccan ore in an installation situated at Pomblière-Saint-Marcel (Savoie) and owned by Métaux Spéciaux S.A.

Iron Ore.—Iron ore, with an approximate average iron content of 30%, was produced from three major basins, East (Est), West (Ouest), both in the north of France, and the Pyrenees Basin. The East basin, located in Lorraine, was the largest, accounting for about 96% of iron ore output. Because of the economic depression and lower steel production, activities at the mines were limited to production of smaller quantities of iron ore than in the past but with no major projects for expansion. In addition, strikes and decreases in iron ore reserves were among contributing causes to the lower output than in 1976. At yearend, stocks at the mines totaled 7.8 million tons of iron ore, the same as 1976. Domestic iron ore supplied 71% of the total domestic demand. Imports of high-grade iron ore leveled off; they were used both to supply coastal steel plants and to blend with low-grade domestic ores. Principal suppliers of iron ore imports (more than 1.5 million tons each) were Mauritania, Australia, Liberia, and Sweden. During 1977, exports of iron ore, largely to the nearby Belgium-Luxembourg steel industry, declined 23% when compared with 1976. The decline in exports resulted from strong competition of phosphorus ore imported from Sweden and sold in Belgium, the traditional buyer of French iron ore.

Iron and Steel.—The French steel industry came to the brink of disaster in 1977. Production was low, prices dropped, and industry debt ballooned as high operating losses continued. Action of the French Government and the EEC during the year prevented the industry from collapsing financially, and at yearend aid plans took hold, and some hope for the industry remained.

In addition to EEC plans to stabilize the steel industries of its members, the French Government established an aid plan for the industry. The "Plan Acier" (Steel Plan) included: A special labor agreement between the producers' association and the labor unions to facilitate a reduction of the workforce by 16,000 employees through mid-1979. The reduction was to be carried out mostly through early retirement and transfers, but was to be accompanied by rationalization and modernization of the structures, both physical and financial, of the industry; it was expected to be signed shortly by at least one of the other major reformist unions.

The physical rationalization includes re-

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ductions in overall capacity through 1980, followed by reduced growth rates and a reorientation of production toward more finished products. This facet of the plan had already entailed the closing of several of the most obsolete facilities, most of which were located in the Lorraine region. During 1977, the financial rationalization led to the reorganization of two of the major holding companies, Marine-Wendel and Chiers-Chatillon, and to loans from the "Fonds de Développement Economique et Social" (FDES) amounting to 1.3 billion francs. An interministerial task force was organized to supervise the use of the funds. An additional 500-million-franc loan was made by the FDES during the first quarter of 1978.[2]

Geographically, the rationalization measures undertaken resulted in a shift in production toward the regions equipped with more modern facilities and with easier access to maritime shipping for both raw materials and finished products. The principal loser in this shift was the Lorraine region which has historically been steel country in France. Production in this area fell more than 10%. The Southeast, due to the increase in production at the modern (1974) facility of Société Lorraine et Méridionale a Laminage Continu (SOLMER), near Marseille, increased its production by 38%. The North, another historically important producing region, experienced a 9% decrease in production.[3]

Output of the French steel industry by geographical region is shown in the following tabulation, in thousand tons:

Region	Steel	
	1976	1977
East (Est)	10,932	9,814
North (Nord)	7,932	7,185
Center (Centre)	896	784
Southwest (Sud-Ouest)	138	127
Southeast (Sud-Est)	2,517	3,483
West (Ouest)	800	701

The growth of oxygen steelmaking in France since 1960, at the expense of the Thomas and Martin processes, is shown in the following tabulation, as a percent of total steel output:

Process	1960	1970	1976	1977
Oxygen	0.6	29.0	68.3	73.5
Electric	8.6	11.0	14.2	14.5
Thomas	60.5	41.1	11.8	8.9
Martin	29.7	18.6	5.7	3.1
Other	.6	.3	--	--

In 1977, the principal steel producers, their production in million tons, and major plants were as follows:

Sacilor-Aciéries et Laminoirs de Lorraine S.A. (SACILOR) (6.0), with plants at Boussange near Grandrange, Usine de l'Orne-Amont near Homécourt, and Rombas and Hagondange, Moselle Department.

Société Lorraine de Laminage Continu (SOLLAC) (2.0), with plants at Hayange, Knutange, Sermange, Ébange, and Florange, all in Moselle.

Société Lorraine et Mériodionale a Laminage Continu (SOLMER) (1.6), at Fos-sur-Mer near Marseille.

CREUSOT-LOIRE, Entreprise S.A. (1.3), with plants at Le Creusot, St. Etienne Leffrincroucke near Dunkerque, Imphy, and Firkny (Loire).

Lead.—France remained dependent on imports of lead concentrates to meet its smelter demand; in 1977 this dependence was close to 75%. Morocco, Ireland, and the United States were the principal suppliers.

BRGM's exploration activities resulted in confirmation of a lead-zinc deposit at Guerdèriene (Côtes-du-Nord) and of another deposit of lead-zinc and silver at Crozes (Aveyron); these were offered to the industry for further development.

Complex ore deposits of lead, zinc with silver, and copper in Brittany, discovered in the past, were of principal interest to BRGM. Results of activities were mixed during 1977. At Bodennec (Finistère), complexity of the deposit and complexity of concentration indicated that production would be uneconomic at prevailing prices for lead. At a deposit explored jointly by BRGM and Societé Nationale Elf Aquitaine (SNEA), located at Porte-aux-Moines (Côtes-du-Nord), richer ores without metallurgical problems raised hopes that one flotation plant for Moines and Bodennec ores could make economics of the Bodennec ores more attractive.

Increased production of domestic mines resulted chiefly from higher output by the Farges mine (Corrèze). The following tabulation shows the mine output for recent years in tons of lead concentrate:

	1976	1977
Largentière (Ardèche) (Peñarroya)	32,600	31,750
Malines (Gard) (Peñarroya)	3,000	3,025
Farges (Corrèze) (Société Minière de Corrèze)	3,200	6,600

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The Imperial smelter at Noyelles-Godault (Pas de Calais, annual capacity 130,000 tons), owned by Peñarroya, remained the only primary lead smelter in operation in the country. In addition, Peñarroya operated secondary smelters at Saint-Denis, Villefranche-sur-Saône, and Escaudoeuvres. Aggregate production from secondary plants, including lead content of antimonial lead, was about 57,000 tons in 1977.

Imported lead supplied 21% of domestic demand. Largest suppliers of lead and lead alloys were Belgium (39%) and the Federal Republic of Germany (26%).

Nickel.—Based on imported nickel matte from New Caledonia, Société le Nickel (SLN) remained the sole nickel producer in France in 1977. SLN continued construction of a new nickel plant at Sandouville, near Le Havre, to replace the existing one, which could no longer meet market specifications. The new electrolytic nickel plant will have a capacity of 15,000 tons per year of high-purity nickel. Startup was scheduled for mid-1978. French consumption of nickel was about 18,300 tons, including metal in oxides.

Tungsten.—During 1977, France was the principal tungsten producer among the EEC countries. Two mines were in operation; the larger producer, the Salau mine (Ariège) operated by Société Minière d'Anglade and the smaller producer, the Enguialès mine (Aveyron), operated by Société Minière et Chimique du Chatelet.

BRGM and SNEA conducted exploration for tungsten in the Central Massif but had made no announcement of major discoveries at yearend.

Zinc.—Higher production of zinc resulted from increased output of high-grade ores from the Saint-Salvy (Tarn) mine, which started production in 1975. The following tabulation shows preduction at French zinc mines, in tons of zinc concentrate:

	1976	1977
Saint-Salvy (Tarn)	43,700	52,000
Les Malines (Gard)	19,210	20,580
Largentière (Ardèche)	8,460	10,100
Total	71,370	82,680

Peñarroya was the only mine zinc producer in France, supplying approximately 15% of zinc concentrate consumption. Canada, Peru, Sweden, and Ireland were the major foreign suppliers.

At the electrolytic plant at Vivier (Aveyron), owned by Vieille Montagne, construction of a plant for treatment of residues from electrolysis was completed. Trials were conducted during the second half of the year, and regular production should start in 1978. Capacity was not made public.

Three companies smelted zinc in France: Vieille Montagne operated the Vivier plant and a plant at Creil; Compagnie Royale Asturiennes des Mines produced electrolytic zinc at Auby; and Peñarroya operated its Imperial smelter plant at Noyelles-Godault.

Domestic production of smelter zinc in France during 1977 was 92% of primary metal consumption. Countries of the EEC were major suppliers of zinc to France and purchasers of French zinc.

NONMETALS

Andalusite.—Andalusite was produced from the Glomel deposit in Brittany. Denain-Anzin Minéraux S.A. produced about 30,000 tons of andalusite concentrates containing 59% Al_2O_3 and about 1% Fe_2O_3. Andalusite schist, containing about 15% of andalusite crystals that are several centimeters long, are encountered under very shallow overburden. The opencast mine is worked in 15-meter benches. The ore is blasted, crushed, and ground to a maximum size of 1.6 millimeters; it is upgraded by electromagnetic separation and a double circuit heavy-media unit. Proven reserves were reported at 4 million tons of ore. The final product is used by the European refractory industry.

Barite.—During 1977, the management of Barytine de Chaillac (Indre Department) undertook measures to increase recovery of barite. Crushing plants were modernized, new flotation circuits were added, and new buildings for storage were constructed.

La Société Industrielle du Centre operated a mine at the Rossignol deposit. There was a delay in exploration because some difficulties were encountered in acquiring land titles.

France remained a net exporter of barite, with the Federal Republic of Germany and the Netherlands continuing as the largest purchasers.

Cement.—Approximately 82% of cement capacity was controlled by 4 companies, the 2 largest of which were Société des Ciments Français S.A. with 22 plants and Ciments Lafarge France with 18 plants. France had a total installed capacity of 40.4 million tons of cement per year; during 1977, the cement industry operated at 70% of capacity.

Fertilizer Materials.—The French Government started to implement its plan for restructuring the French fertilizer industry into two new groupings, one each in the public and private sectors. In the public sector, the two Government-owned com-

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panies, CdF-Chemie and Entreprise Miniére et Chimique, were to merge their fertilizer interests. In the private sector, the finalization of regrouping was not announced at yearend.

Phosphate.—France had no significant production of phosphate rock during 1977. A small output of about 19,000 tons of phosphatic chalk, with an average P_2O_5 content of 10%, from deposits in the Département de la Somme was the only natural source of phosphate in the country. However, slag from iron and steel plants continued to supply phosphorus, accounting for 15% to 20% of the total. The rest of the country's demand was met through imports from Morocco, Senegal, Togo, Tunisia, and others.

Potash.—Restructuring of the potash industry and experiments for production of potash by solution mining continued during 1977. However, in both fields results were modest.

The Government-owned Mines de Potasse d'Alsace (MDPA), part of the Government-owned Entreprise Miniére et Chimique, remained the only producer of potash in France from mines located in Alsace near Muhlhouse. Domestic output was more than adequate to meet the demand, and France was a net exporter of potash.

Fluorspar.—Demestic output of fluorspar was more than adequate to meet demand, and France was a net exporter. However, production and consumption declined, mostly because of the slowdown in the steel industry. A decrease in production at Langeac (Haute-Loire) was attributed to the mining of lower grade ores.

The largest producers of fluorspar were as follows: Sogerem/Secme (Péchiney-Ugine-Kuhlmann), which produced acid-grade fluorspar at Montroc (Tarn), Fontsante (Var), and Langeac (Haute-Loire) and metallurgical-grade fluorspar at Alban (Tarn), with a total acidspar capacity about 120,000 to 130,000 tons per year and a metspar capacity around 25,000 tons per year; Denain-Anzin Minéraux (Denain Nord-Est Longwy), with mining operations at Prades (Pyrénées Orientales) which supplies the 75,000-ton-per-year acidspar plant at nearby Olette and the 50,000-ton-per-year metspar pelletizing plant at Ria; Comifluor (owned by Péchiney-Ugine-Kuhlmann and Denain-Anzin Minéraux), which operates the flotation plant at Olette; Mines de Garrot (now a Talcs de Luzenac associate), which produces around 8,000 tons per year of metspar in conjunction with barite operations at Les Arcs (Var), although actual mines are at Pic Martin and Vallon de Largentière; and Cie. Française des Minerais d'Uranium (CFMU), which produces up to 60,000 tons per year of metspar, plus a smaller output of fines, from operations near Autun (Saône-et-Loire).

France was a net exporter of fluorspar, and the largest purchasers remained the Federal Republic of Germany, Italy, and Sweden.

Talc.—Talc was produced by Talcs de Luzenac at its mine and plant near Luzenac sur Ariège. No major events were reported. France was a net exporter of talc; the Federal Republic of Germany, the United Kingdom, and the United States were the major purchasers.

MINERAL FUELS

France was almost totally dependent on imports for crude oil and was partly dependent on imported solid fuels and natural gas. Coal was the major fuel produced in the country. The fuel position of France is shown in table 5.

Table 5.—France: Supply and apparent consumption of fuels and power

(Million tons of standard coal equivalent[1])

	Total primary energy	Coal and coke	Petroleum and refinery products	Natural gas	Fuelwood	Hydroelectric power	Nuclear power
1975:							
Production	48.0	26.7	2.6	9.7	(2)	7.3	1.7
Imports	214.6	21.3	178.3	15.0	(2)	(2 3)	(2 3)
Exports	19.6	1.7	17.9	--	(2)	--	--
Apparent consumption	243.0	46.3	163.0	24.7	(2)	7.3	1.7
1976:							
Production	50.2	26.5	2.8	9.3	(2)	9.5	2.1
Imports	234.2	21.2	192.3	18.7	(2)	2.0	(3)
Exports	21.4	1.5	19.9	--	(2)	--	--
Apparent consumption	263.0	46.2	175.2	28.0	(2)	11.5	2.1

[1]1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2]Less than 1/2 unit.
[3]Includes all kinds of electric power.

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Coal.—Coal production and consumption in France continued to decline although energy use increased. The sluggish performance of the iron and steel industry and consequent consumption of coke affected the demand for coal.

After several years of negotiations, the operating entity of the largely nationalized French coal industry, Charbonnages de France (CdF), concluded an agreement with the French authorities concerning subsidies to CdF by the French Government. According to the terms of the contract, the French Government will cover all expenses of CdF not related to production, such as costs of retraining miners and losses related to prices set by the French Government below market prices.

The French coal industry was concentrated in three areas: Nord-Pas-de-Calais (northern France), Lorraine (northeastern France), and Centre-Midi (central and southern France). Mines in the Centre-Midi basin were grouped in seven subbasins: Aquitaine, Auvergne, Blanzy, Cévannes, Dauphiné, Loire, and Provence. All mines in these areas were operated by CdF. Only one non-nationalized company, Houillères de Cruéjouls, was in operation in 1977, with mines in the Arjuzanx subbasin, south of Bordeaux, which delivered lignite to a powerplant at d'Alibi.

Production figures for various coal basins, by type of coal, are shown in the following tabulation in thousand tons:

	1975	1976	1977
Anthracite and bituminous:			
Nord-Pas-de-Calais	7,715	7,318	6,641
Lorraine	10,021	9,970	10,033
Centre-Midi:			
Aquitaine	1,084	1,067	1,044
Auvergne	414	417	397
Blanzy	1,554	1,553	1,328
Cévannes	822	607	555
Dauphiné	384	407	362
Loire	420	540	434
Other	10	--	--
Total	22,424	21,879	21,294
Lignite:			
Centre-Midi, Provence	1,545	1,556	1,272
Region Landaise	1,641	1,632	1,808
Total	3,186	3,188	3,080
Grand total	25,610	25,067	24,374

Source: Annales des Mines, Paris. No. 9-10, September-October 1978, p. 101, Sec. 11.

Mining conditions in French coal mines were difficult. Most of the mines were deep, gassy, and with thin, almost vertical, seams. However, only 1.7% of all mines were unmechanized, and those few mines with thick, horizontal seams were highly mechanized.

Salient statistics of the coal industry are shown in table 6.

Table 6.—France: Salient statistics of the coal industry

(Thousand metric tons unless otherwise specified)

	1975	1976	1977
Production, bituminous and lignite	25,610	25,067	24,374
Imports, bituminous, lignite, coke, briquets	r20,413	21,765	23,784
Exports, bituminous, lignite, coke, briquets	r1,291	1,636	1,428
Apparent consumption of solid fuels	44,732	45,196	46,730
Average number of days worked, all mines	234	233	232
Average daily output, all mines	109	107	105
Number of workers:			
Underground, all mines	41,032	37,697	34,124
Overall, all mines	85,413	80,733	75,031
Production per work-shift (kilograms):			
Underground, all mines	2,889	2,916	3,011
Overall, all mines	1,888	1,918	1,994
Stocks at yearend, all mines	6,162	4,887	5,409

rRevised.

About 90% of French coal must be washed. Of the coal washed in 1977, about 57% was processed in installations with dense media; installations with piston jigs and flotation plants processed 33% and 10% of the run-of-mine coal, respectively. Capacity of all coal washeries was about 14,600 tons per hour of run-of-mine coal at yearend 1977.

France imported about 50% of its solid fuels during 1977. Imports of coal increased, but imports of coke declined. Imports from countries outside the EEC increased to 65% of total imports. Coal deliveries from the Republic of South Africa and Australia, newcomers on the French market, almost doubled when compared with coal imports of 1976.

Coke.—Reconstruction continued on the large coking complex at Carling in Lorraine. Battery No. 1 was shut off, and battery No. 2 was readied for industrial

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production after completion of tests. Production of coke and semicoke in the three basins at the steel coking plants, in thousand tons for 1975-77, was as follows:

Basin	1975	1976	1977
Nord-Pas-de-Calais	3,112	2,836	2,412
Lorraine	2,139	2,052	1,952
Centre-Midi:			
Aquitaine	414	399	365
Total	5,665	5,287	4,729
Coking plants at steelmills	r5,220	r5,370	5,887
Gas coking plants and independent producers	455	453	456
Grand total[1]	r11,340	r11,110	11,072

rRevised.
[1]Data differ from those reported in table 1, owing to a difference in source.

Sources: Charbonnages de France. Rapport de Gestion 1977 (Paris). 1977, p. 76; and Annales des Mines, Paris. No. 9-10, September-October 1978, p. 119.

At yearend 1977, installed capacity in French coking plants at basins was about 17,755 tons of coke per day. During 1977, coking plants at basins operated at about 73% of installed capacity.

The outflow of coke and semicoke to various sectors of the economy, in thousand tons and percentage of total during 1975-77, was as follows:

	1975	Percent	1976	Percent	1977	Percent
Steel industry	2,638	54.3	2,873	54.5	2,255	50.1
Other industries	1,008	20.8	957	18.2	1,000	22.2
Small industries	157	3.2	132	2.5	115	2.6
Exports	642	13.2	880	16.7	686	15.3
Household consumption	410	8.5	429	8.1	441	9.8
Total	4,855	100.0	5,271	100.0	4,497	100.0

Source: Charbonnages de France. Rapport de Gestion (Paris). 1977, p. 74.

Natural Gas.—Construction continued on an additional 80,000 cubic meters of underground storage space for gas in the general area of Fos, a port in southern France on the Mediterranean Sea.

Domestic output accounted for about 30% of the apparent demand of the country. The Netherlands remained the principal supplier and accounted for 70% of total imports of natural gas.

Based on existing plans, natural gas should provide 16% of the energy demand in 1985. Algeria should provide the bulk of French imports by 1990.

Petroleum.—As in the past, France was almost totally dependent on imported crude oil to meet the requirements of domestic petroleum refineries.

Exploration and Production.— During 1977, efforts were made to increase domestic crude oil production, but results were not encouraging. A total of 34 wells with 86,943 meters were drilled. Of 14 exploratory wells, with 44,724 meters drilled, only 1 was a producer. Esso S.A.F.'s well, Vulaines 1 in the Paris basin, discovered oil in the Jurassic Dogger between 1,889 and 1,910 meters. During production the test well flowed at a rate of 6.6 cubic meters per day from the fractured oolitic limestone. The well was completed and acidized through a perforated 7-inch liner. The 20 preduction wells, totaling 42,219 meters, were mostly drilled in fields in Aquitaine.

Domestic production of crude oil and condensates was only about 1% of the total refinery throughput of France. In addition to domestic production, French interests controlled production of about 75.1 million tons per year, or about one-third of French consumption, in various ventures abroad. Approximately 55% of total investment in foreign oil consisted of participations in North Sea ventures.

Refining.—During 1977, French petroleum refineries, with a total installed capacity of 171 million tons of crude, processed 118 million tons or 69% of capacity. Countries of the Persian Gulf accounted for about 76% of total refinery throughput. Countries of the Mediterranean basin followed with 9%. Nigeria supplied about half of the remaining deliveries. An older 2-million-ton-per-year petroleum refinery at Ambes

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(Gironde), owned by Elf France, was closed as obsolete. Table 7 shows ownership, location, and capacities of petroleum refineries in France.

Table 7.—France: Ownership, location, and capacity of petroleum refineries for 1977

(Million tons of crude oil)

Operator	Location	Capacity Dec. 31, 1977
Cie. Française de Raffinage	Flandres (Nord)	6.3
Do	Gonfreville (Seine Maritieme)	22.3
Do	La Mède (Bouches-du-Rhône)	10.5
Subtotal		39.1
Esso S.A.F	Port Jérôme (Seine Maritieme)	7.2
Do	Bordeaux (Gironde)	2.9
Do	Fos-sur-Mer (Bouches-du-Rhône)	8.0
Subtotal		18.1
Shell-Française	Petit-Couronne (Seine Maritieme)	18.8
Do	Pauillac (Gironde)	4.0
Do	Berre (Bouches-du-Rhône)	13.5
Subtotal		36.3
Mobil Oil Française	Gravenchon (Seine Maritieme)	3.6
Do	Frontignan (Hérault)	5.7
Subtotal		9.3
S.F. B.P	Dunkerque (Nord)	5.2
Do	Lavéra (Bouches-du-Rhône)	11.5
Do	Vernon (Eure)	3.4
Subtotal		20.1
Elf France	Donges (Loire-Atlantique)	9.0
Do	Vern-sur-Seichen (Ille-et-Vilaine)	1.5
Do	Valenciennes (Nord)	3.3
Do	Ambès (Gironde)	[1]
Do	Feyzin (Rhône)	9.1
Do	Grand Puits (Seine-et-Marne)	5.0
Do	Vexin (Yvelines)	6.5
Subtotal		34.4
Cie. Rhenane de Raffinage	Reichstet (Bas-Rhin)	4.2
Sté. de la Raffinerie de Strasbourg	Herrlisheim (Bas-Rhin)	4.6
Sté. de la Raffinerie de Lorraine	Hauconcourt (Moselle)	5.1
Total		171.2

[1]Closed during 1977.

Transportation.—During 1977, the French tanker fleet comprised 82 tanker ships with a total deadweight capacity of 16.2 million tons. The average deadweight capacity was 200,000 tons. Four new tankers, with a deadweight capacity of 1.0 million tons, were commissioned during the year; one of them was the largest tanker in the world, the 555,000-deadweight-ton tanker *Pierre Guillaumat*. Five tankers, with a total tonnage of 0.4 million deadweight tons were decommissioned. Tankers under the French flag moved 81% of the crude oil delivered to France.

Several crude oil pipelines with a total length 3,700 kilometers were in service and moved about 71 million tons of crude oil during 1977. In addition, about 20 million tons of petroleum products were moved through two pipelines with a length of about 1,768 kilometers.

Uranium.—The French Government and the private sector remained active in uranium mining and processing at home and abroad. A Government-owned company, Compagnie Général des Matières Nucléaires (COGEMA), was the largest operator. In France, COGEMA explored around the mining districts of Limousin, Vendée, and Forez. In addition, exploration continued in central France in Rouergue, Lauragais/Castrais, Berry, and Bourbonnais/Morvan. Private companies, MINATOM in particular, explored in the Central Massif, Brittany, and Aquitaine.

COGEMA continued exploration and research to concentrate ores, and made an economic evaluation of the Lodève, Hérault deposit, which produces a carbonate ore that is difficult to treat. At yearend, technical problems appeared solved, but exploitation still appeared uneconomic.

Compagnie Minière Dong-Trieu continued preparations for startup of an opencast mine and concentrator at its concession at Mailhac-sur-Benaize. Production was

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scheduled for 1979.

Uranium in France was produced by COGEMA, Société Central de l'Uranium et des Minerais et Métaux Radioactifs (SCMURA), Compagnie Française de Minerais d'Uranium (CFMU), Société Industrielle et Minière d'Uranium (SIMURA), and Société des Mines d'Uranium du Centre (SMUC), a subsidiary of CFMU, COGEMA, and Société des Asphaltes du Centre.

The following tabulation shows mine production of uranium in metric tons:

Company	Location of mine	Ore	Uranium content
COGEMA	Limousin	521,000	842
Do	Vendée	312,000	503
Do	Forez	137,000	512
CFMU	Lozère	136,000	136
Do	Creuse	16,500	56
SIMURA	Morbihan	8,600	36
SMUC	Corrèze	8,000	51
SCUMURA	Cantal/Creuse	58,000	100
Total		1,197,100	2,236

Source: Annales des Mines, Paris. September-October 1978, p. 34.

This tabulation includes low-grade ores (0.02%) produced by COGEMA at Limousin and Vendée and by CFMU at Lozère.

A sixth yellowcake plant started production in 1977. Three plants, Bessines, l'Escarpiere, and Bois Noir, were operated by the Société Industrielle de l'Ouest (SIMO); one by CFMU at Lozère; one by COGEMA at Guingnon; and the new one by SCMURA at Sain Pierre-du-Cantal.

At Lozère, expansion of the concentrator was completed with the addition of one beneficiation unit to the existing plant. The Lozère plant has a capacity of 200 tons of uranium per year.

[1]Physical scientist, Branch of Foreign Data..

[2]U.S. Embassy, Paris, France. State Department Airgram A-114, Industrial Outlook Report, French Iron and Steel Industry.

[3]Work cited in footnote 2.

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The Mineral Industry of Gabon

By Candice Stevens[1]

Gabon's mineral sector contributed approximately 65% of the 1977 gross national product (GNP) estimated at $3 billion,[2] with revenues derived chiefly from petroleum, uranium, and manganese production. Despite having one of the highest per capita incomes in Africa, Gabon's economy suffered from problems engendered by inflation, a small labor force, and a large external debt. Inflation was estimated at 20% to 25% in 1977, and expatriate labor was being used in development projects. In 1977, Gabon received standby credit of $18 million from the International Monetary Fund to help curb the inflation rate and improve the public debt situation.

In the third 5-year plan (1976-80), the Government mounted an ambitious program to develop the country's natural resources and create a diversified industrial base. Expenditures were dependent upon levels of petroleum production. The basic plan, which projected investments totaling $3.5 billion, was founded on a decrease in oil production to 8.3 million tons per year by 1980; an alternative plan, which would involve investments of nearly $4 billion, assumed that production would be maintained at the annual rate of 11 million tons through 1980 by exploitation of new petroleum discoveries. The Government was also enforcing the Provision pour Investissements Diversifiés (PID), which required that petroleum companies invest up to 10% of their profits in industrial ventures in Gabon. The choice of investment must receive the approval of the Government, which then acquires a 51% interest in the venture. In the mineral sector, projects being financed through PID funds included the Cie. Gabonaise—ELF de Raffinage (COGER) refinery, the Soc. des Ciments de Gabon cement plant at Ntoum, the nitrogen fertilizer plant at Port Gentil, and the Soc. Nationale de Transportation Maritime (SONATRAM) tanker fleet.

Work continued throughout the year on the Trans-Gabon Railroad, which is to link the manganese mines at Moanda, the uranium mines at Mounana, and the iron ore deposits at Belinga to a deepwater port under construction at Santa Clara, 15 kilometers north of Libreville. The total length of 950 kilometers comprised a 340-kilometer link from Owendo to Booué; a 360-kilometer link between Booué, Moanda, and Franceville; and a 250-kilometer section connecting Booué and Belinga. The 13-company European consortium constructing the railroad planned to inaugurate the first link between Owendo and Ndjolé in early 1978. Annual capacity of the railroad is to be 2.2 million tons of timber, 2 million tons of manganese, 10 million tons of iron, 60,000 tons of hydrocarbons, and 500,000 tons of miscellaneous goods, in addition to passengers.

PRODUCTION AND TRADE

Production of Gabon's major mineral commodities—manganese, uranium, and crude petroleum—decreased from the 1976 levels. Manganese production is scheduled to increase from the current rate of around 2 million tons per year to approximately 4

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million tons per year upon completion of the Trans-Gabon Railroad. Uranium production is to undergo a 50% increase in capacity upon commissioning of the underground mine at Oklo. Production of petroleum is expected to remain at the 11-million-ton-per-year level, assuming that new fields supplement a decline in output from older deposits. New cement plants and a new petroleum refinery are to augment the production of these commodities. Gabon also produced small amounts of gold and nonmetals.

Mineral exports accounted for approximately 91% of the total export value in 1977. However, a reduction in the current balance-of-trade surplus was projected, owing to declining petroleum exports. Petroleum, which provided 81% of the export earnings, was sold primarily to the United States, France, and other African countries. Manganese was the second largest earner (8% of the total export value) and was exported to the United States and Canada (40%), France (22%), Japan (10%), and other Western European countries. Virtually all uranium production was exported to France.

Transport congestion at the two main trading centers of Owendo and Port Gentil was to be eased by expansion of Gabon's port facilities. Construction began in April 1977 on extensions to Port Gentil, including the addition of two 600-meter docks. A new $100 million mineral port was also under construction at Santa Clara. The port complex, being built by Soros Associates (United States), is to include a breakwater-protected harbor where general cargo, metallurgical coke, and miscellaneous metallurgical products can be handled. Two belt conveyors were being designed to carry 8,000 tons of iron ore and 4,000 tons of manganese per hour. Manganese, uranium, and iron ore are to be transported to Santa Clara by the Trans-Gabon Railroad for direct shipment.

Table 1.—Gabon: Production of mineral commodities[1]

Commodity		1975	1976	1977[p]
Gas, natural:				
Gross	million cubic feet	60,458	64,484	[e]63,780
Marketed	do	[r]9,252	5,968	[e]6,000
Gold, mine output, metal content	troy ounces	[r]4,212	3,086	2,572
Manganese:				
Ore, gross weight (50%-53% Mn)	thousand metric tons	[r]2,205	2,152	1,773
Pellets, battery and chemical grade, gross weight (82%-85% MnO_2)	do	[r]40	65	78
Total	do	[r]2,245	2,217	1,851
Petroleum:				
Crude	thousand 42-gallon barrels	[r]81,948	82,042	81,144
Refinery products:				
Gasoline	do	1,097	1,260	--
Jet fuel and kerosine	do	753	870	--
Distillate fuel oil	do	1,864	2,845	14,490
Residual fuel oil	do	2,113	4,554	--
Other	do	44	695	--
Refinery fuel and losses	do	574	999	--
Total	do	6,445	11,223	14,490
Uranium oxide (U_3O_8), content of concentrate	metric tons	1,097	1,085	932

[e]Estimate. [p]Preliminary. [r]Revised.

[1]In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone) is also produced, as well as diamond from artisan works, but output is not reported and available information is inadequate to make reliable estimates of output levels.

Table 2.—Gabon: Exports of mineral commodities

Commodity	1975	1976	Principal destinations, 1976
Manganese ore thousand metric tons	1,968	2,217	United States 932; France 438.
Petroleum, crude thousand 42-gallon barrels	75,631	76,739	France 32,240; United States 13,055; Islands of the Caribbean, n.e.s., 10,505; Bahamas 9,513.
Uranium and thorium ores and concentrates value, thousands	$10,785	$35,055	All to France.

Source: United Nations. Commodity Trade Statistics. 1975 and 1976.

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Table 3.—Gabon: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum metal including alloys, unwrought and semimanufactures	537	385	France 236; Belgium-Luxembourg 103.
Copper metal including alloys, unwrought and semimanufactures	5,536	80	France 66.
Iron and steel semimanufactures:			
Bars, rods, angles, shapes, sections	26,178	29,617	France 25,222; Belgium-Luxembourg 3,564.
Plates and sheets	7,103	8,070	France 6,643.
Hoop and strip	--	172	NA.
Rails and accessories	1,026	20,930	Mainly from France.
Wire	1,710	1,459	France 858; Belgium-Luxembourg 197.
Tubes, pipes, fittings	48,004	39,135	France 21,523; Japan 6,332; United States 5,046.
Castings and forgings, rough	--	147	All from France.
Total	84,021	99,530	
Zinc metal including alloys, unwrought and semimanufactures	34	NA	
NONMETALS			
Abrasives:			
Natural	633	NA	
Grinding stones and wheels	46	132	Mainly from France.
Cement, hydraulic	138,951	183,840	France 101,306; Angola 46,884; Ivory Coast 20,124.
Clay products:			
Refractory	110	18	Mainly from France.
Nonrefractory, including brick	5,424	3,264	France 2,064; Italy 508; West Germany 380.
Salt	1,914	1,685	France 161.
Stone, sand and gravel:			
Crude and partly worked:			
Calcareous stone	3,642	572	NA.
Gravel and crushed rock		12,329	Mainly from France.
Other		155	NA.
Building stone, worked	NA	176	NA.
Sulfur, elemental	NA	3,023	All from France.
Other, crude:			
Refractory	5,766	3,833	United Kingdom 1,549; Senegal 1,050; Spain 512; France 392.
Other, unspecified	332	13,674	France 10,417; Morocco 1,751.
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	9	11	Mainly from Netherlands Antilles.
Lubricants do	42	30	France 16; Belgium-Luxembourg 10.
Bitumen and petroleum coke do	81	13	Spain 11.
Other do		3	NA.
Total do	132	57	

NA Not available.

Source: United Nations. Commodity Trade Statistics. 1975 and 1976.

COMMODITY REVIEW

METALS

Gold.—Gold sales by Soc. Gabonaise de Recherches et d'Exploitations Minières (SOGAREM) have been declining in recent years and fell to about 2,600 troy ounces in 1977. Gold was produced by independent workers in the areas of Etéké, Lastoursville, Makokou, and Ndjolé. SOGAREM, in conjunction with Bureau des Recherches Géologiques et Minières (BRGM), continued its investigation for deposits to supplement the older workings.

Iron.—The completion of the Trans-Gabon Railroad is to enable exploitation of the Mekambo group of iron ore deposits on the Ivindo River at Belinga. Iron ore mining is to be undertaken by Soc. des Mines de Fer de Mekambo (SOMIFER), a multinational consortium of steel companies, in partnership with the Gabonese Government. In 1977, a study was in progress to determine the reserves and average phosphorus content of the Mekambo deposits, where re-

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serves were previously estimated at 566 million tons averaging 65% iron. Exploitation of the deposits was tentatively scheduled for 1982 at an average annual rate of 10 million tons of ore. Output is to be transported by the Trans-Gabon Railroad to the new ore-handling port of Santa Clara, which is to be capable of accommodating carriers of 250,000 deadweight tons. Exploration for iron ore was also being conducted in the Tchibanga region in southwestern Gabon.

Manganese.—Gabon, the world's third largest producer of manganese, produced nearly 1.8 million tons of metallurgical-grade ore and 78,000 tons of battery- and chemical-grade ore in 1977. Reserves at Moanda, situated 50 kilometers west of Franceville, were estimated at 210 million tons of salable product grading 48% manganese. Open pit mining since 1962 has been under the direction of Cie. Minière de l'Ogooué (COMILOG), owned by United States Steel Corp. 44.1%, BRGM 19.8%, Cie. de Mokta 17.1%, the Gabonese Government 10%, and Soc. Auxiliaire du Manganese de Franceville 9%. Production is expected to reach 4 million tons of manganese annually upon completion of the Trans-Gabon Railroad. Ore has been transported by a 76-kilometer, overhead chain conveyer from Moanda to Mbinda on the Congolese border, then along a 286-kilometer stretch of the Chemin de Fer Congo-Ocean railroad for export from the port of Pointe-Noire. COMILOG continued its investigation of manganese deposits on the Okouma Plateau north of Moanda; the Gabonese Government planned to take a 10% to 25% interest in any venture to exploit the deposits.

The major share of the high-grade ore produced by COMILOG was used to produce batteries by Soc. Gabonaise des Piles (SOGAPIL). The SOGAPIL plant, which had a production capacity of 6 million 1.5-volt batteries per year, was owned 20% each by the Gabonese Government, Wonder Industries Corp., and COMILOG, with the remaining shares divided among private banks and individuals. Output was sold for domestic use and exported to the Congo and Zaire.

Soc. Gabonaise des Ferroalliages (SOGAFERRO) continued its study of construction of a ferroalloys plant at Franceville. Production of 85,000 tons of ferromanganese and 50,000 tons of silicomanganese was scheduled to begin in 1981, pending completion of the Grand Poubara Dam. Principal shareholders in SOGAFERRO were Okura Trading Co., Ltd. (Japan) 25%, COMILOG 15%, the Gabonese Government 10%, Union Carbide Corp. (United States) 10%, Acièries de Paris et d'Outreau (France) 10%, Elkem-Spigerverket A/S (Norway) 10%, Applications de la Chimie de l'Electricité et des Métaux S.A. (SADACEM) (Belgium) 10%, and Tassara (Italy) 10%. The production of the $75 million plant is to be exported to the United States, Europe, and Japan.

Uranium.—The production capacity of Cie. des Mines d'Uranium de Franceville (COMUF) is to increase from 1,000 tons of U_3O_8 in 1977 to 1,500 tons in 1980. Preparations were underway for underground mining at the Oklo uranium deposits, currently being mined by opencast methods, to begin in 1978. Feasibility studies were also being conducted on exploitation of the Boyindzi and Okelobondo deposits. Total reserves at the three deposits, all located in the Mounana area 25 kilometers north of Moanda, were estimated at 20,000 tons of uranium metal. Ownership in COMUF was divided among Cie. de Mokta (28.13%), the Gabonese Government (25%), France's Commissariat à l'Énergie Atomique (CEA) (15%), Minatome S.A. (13.12%), Cie. Française des Minerais d'Uranium (7.5%), Cie. de Gestion d'Investissements Internationaux (COGEI) (7.5%), and Cie. des Mines de Huaron (3.75%). CEA continued uranium exploration in its two concession areas near Franceville and Cocobeach.

Uranium ore was processed at the Mounana plant, which had a capacity of 240,000 tons of ore annually and produced preconcentrates containing 35% to 55% uranium metal. Final processing was at the Gueugnon plant in Saône-et-Loire, France. A plant to produce yellow cake with a content of 70% to 75% uranium metal was scheduled for completion at Mounana in 1978. Annual capacity of the plant, which was expected to cost $40 million, was to be 1,000 tons of uranium metal.

NONMETALS

Cement.—Gabon's only clinker-grinding plant, owned by Soc. des Ciments d'Owendo S.A., produced approximately 160,000 tons of cement in 1977. Principal shareholders in the Owendo plant were the Gabonese Government 20% and Ciments Lafarge S.A. (France) 71.3%. Production capacity of the plant was increased to 270,000 tons per year in 1976 by the installation of an additional grinding unit. To reduce dependence on imported cement, two other facilities were under construction. Soc. des Ciments de

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Gabon was created in 1976 to build a clinker-grinding plant with an annual capacity of 100,000 tons at Franceville. A second plant at Ntoum was to produce 350,000 tons of clinker annually from local limestone deposits, where reserves were estimated at 20 million to 30 million tons. Construction of the two facilities was to be by Creusot-Loire Entreprise (France). Shareholders in Ciments de Gabon were the Gabonese Government 51%, Elf Gabon 19%, Ciments Lafarge 15%, and Ciments d'Owendo 15%. Cement production for both domestic use and export was to commence in 1979.

Fertilizer Materials.—Construction continued during 1977 on the nitrogen fertilizer plant at Port Gentil by Soc. Gabonaise de Chimiques. Using natural gas feedstock associated with Gabon's petroleum production, the plant is to have an annual capacity of 60,000 tons of ammonia. Shares in the company were owned by N'Ren Corp. (United States) 35%, Elf Gabon 31.85%, and the Gabonese Government 33.15%. Startup was scheduled for 1978, with the greater share of production to be exported to other African countries.

Marble.—In its first year of operation, the new marble cutting and polishing plant at Tchwanga, near Doussé-Ossou, produced 7,000 square meters of marble. The plant was operated by Soc. Italo-Gabonaise des Marbres (SIGAMA), which was owned by the Gabonese Government 25% and a consortium of Italian firms 75%. Reserves of marble in the area were estimated at 2 million tons. The major share of output was exported to Western Europe.

MINERAL FUELS

Petroleum.—Gabon, Africa's fifth largest producer of petroleum and a member of the Organization of Petroleum Exporting Countries (OPEC), produced approximately 11.2 million tons of oil in 1977. Production was expected to continue at this level for the next few years but was then expected to decline if no new substantial discoveries were made. Although Gabon has a few large oilfields, most of the fields are of moderate size, and approximately 80% of the production originates from ocean deposits. Recoverable oil reserves were estimated at 80 million tons in 1977.

Gabon produced three different types of crude oil: Mandji oil of 30° API gravity in the area of Port Gentil; Gamba oil of 31.7° API gravity in the area near Sette Cama; and Lucina oil of 30.9° API gravity farther south near Mayumba. In 1977, the price of Mandji crude was raised 8.4% from $13.20 to $14.31 per barrel, and the price of Gamba crude was raised 9.7% from $13.50 to $14.81 per barrel.

The largest producer in Gabon was Elf Gabon, owned 75% by Essence et Lubrificants de France—Entreprise de Recherches et d'Activités Pétrolières (Elf-Erap) and 25% by the Gabonese Government. With 13 offshore and 5 onshore fields in production, Elf Gabon had an output of more than 170,000 barrels per day, accounting for about three-fourths of Gabon's production in 1977. The largest producing field was Grondin, which accounted for about one-fourth of total Gabonese production from 20 wells. The Grondin field, situated 80 kilometers south of Port Gentil, was being used as a test site for deepwater production technology. A subsea station operated by electronic remote control, thereby avoiding the need for floating platforms, was installed in 1976. Equipped with production equipment and three production wellheads, the subsea station was placed 60 meters deep, but the equipment and techniques were to be functional at a 600-meter depth. Production from the first well drilled began in December 1976; during 1977, two additional wells were drilled.

Elf Gabon held several joint production ventures with other oil companies. Shell Gabon, owned 25% by the Gabonese Government and 75% by Royal Dutch/Shell, started oil production jointly with Elf Gabon at the Gamba field in 1963 and the Ivinga field in 1968. Elf Gabon, in conjunction with Mitsubishi Oil Co., Ltd., operated the smaller Merou and Baliste fields. Elf Gabon, in partnership with the U.S. firms Ocean Drilling & Exploration Co. and Ocean Oil and Gas Co., also brought the offshore Breme field into production in 1976.

Petroleum exploration continued both onshore and offshore under concessions granted to about 20 international companies and covering approximately 155,000 square kilometers of territory. The terms of the prospecting licenses required producing companies to reinvest up to 10% of their profits in domestic industrial enterprises, Government participation of 25% in case of commercial discovery, refining of 50% of crude output in local facilities, and training of local personnel. In 1977, a total of 40 exploratory and development wells were

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drilled: 31 were completed for oil, 1 was completed for gas, 5 were dry, and 3 were suspended.

The refinery operated by Soc. Gabonaise de Raffinage (SOGARA) produced 1.6 million tons of refined petroleum products in 1977. The refinery, located at Port Gentil, was supplied by crude from the deposits at Ile Mandji by way of an 18-kilometer pipeline. SOGARA was owned 30% by the Gabonese Government, 18.75% by Elf Gabon, 18.75% by Cie. Française des Pétroles, and the remainder by a group of petroleum-marketing companies. Gabon's second refinery, also at Port Gentil, operated by COGER, came into production in 1977 but did not reach full capacity of 1.5 million tons per year. COGER was owned 30% by the Gabonese Government and 70% by Elf Gabon. About 40% of Gabon's production of petroleum products went to Soc. Nationale de Distribution Pétrolière (PIZO), the Gabonese national oil-distribution company. The remainder was sold to Gabon's partners in the Central African Economic and Customs Union, which included Cameroon, the Central African Empire, Chad, and the Congo.

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[1]Economist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Communauté Financière Africaine Francs (CFAF) to U.S. dollars at the rate of CFAF238=US$1.00.

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The Mineral Industry of the German Democratic Republic

By George Rabchevsky[1]

The industrial development of the German Democratic Republic (G.D.R.) is essentially determined by the fact that the country has limited indigenous raw material resources. The G.D.R., therefore, has to rely on its material processing industry and foreign trade. The only marketable raw materials it has are lignite, potash, salt, and feedstock for the cement, glass, and ceramics industries. On a smaller scale, the G.D.R. also mines ores of several nonferrous metals, such as copper and tin, and extracts small quantities of natural gas.[2] In 1977, the G.D.R. remained a world leading producer of lignite and potash. Furthermore, the G.D.R. claims to have the largest chalk deposits in Europe, concentrated on the Baltic Sea Island of Rugen.

Due to its lack of domestic raw materials, the G.D.R. in 1977 had difficulties in coping with the inflation of prices for imported raw materials. For example, 1977 was the third year in succession in which the G.D.R. showed a deficit in its trade balance with the U.S.S.R. and other countries, despite its tremendous export efforts.

The 1977 national income of the G.D.R. increased 5.2% over the previous year's national income, to 155 billion Marks (M).[3] This growth, however, did not meet the Government's goal of a 5.5% increase. Overall, the 1977 economic plan was not met, and tasks planned for 1978 were reduced. Slower growth than was anticipated for national income was mainly due to shortfalls in the 1976 and 1977 harvests. Of all the member countries of the Council for Mutual Economic Assistance (CMEA),[4] the G.D.R. has the highest per capita income. Manufacturing is the G.D.R.'s most important sector, accounting for about 60% of national income, and employing at least 40% of the working population. Industrial production rose 5.4% over 1976 production levels to M94.5 billion, an increase of M13,800 million, compared with the planned target of 5.1%. Despite considerable bottlenecks in the supply of intermediate products and spare parts, production in the manufacturing industry increased in 1977. This increase resulted primarily from steady productivity increases of 6% in 1976 and 5.2% in 1977.[5] The 1977 growth rate (at 1975 prices) for the energy and mining sector was only 4.3% (compared with 6% in 1976); for the processing industry, the growth rate was 5% (compared with 5.6% in 1976); and for the construction industry, the rate of growth was 4.7% (compared with 5.4% in 1976).[6]

The 1977 State budget of the G.D.R. amounted to M122.2 billion, reflecting a growth rate of 4%. An 8% growth rate is planned for 1978. In 1977, M2 billion was spent on research. Capital investments in industry during 1977 increased 9% over 1976 investments, compared with a 7.9% increase in investments from 1975 to 1976. More than half of the G.D.R.'s industrial investment was in heavy industry, especially in the coal and energy, ore mining, metallurgy, and chemical industries.[7] Approximately 60% of the total industrial investments anticipated under the current 5-year plan are earmarked for the raw materials industries. For example, expenditures for research and exploration of minerals are planned to be nearly twice the amount spent for these efforts under the last 5-year plan.[8]

The current 5-year plan (1976-80) calls for total increases of 28% in national income, 34% in industrial production, and 30% in productivity over the 5-year period. Al-

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though during the past 2 years some sectors have fallen short of planned targets, the economic outlook for 1978 is more favorable. The national income in 1978 is expected to rise 5.2% and increases are also forecast for industrial production (5.7%) and in foreign trade turnover (11%). Total expenditures for science and technology in 1978 are planned to amount to over M7 billion, 14% more than was spent in 1976. The 1978 State budget set both revenues and expenditures at M130,617.5 million.[9]

The 1978 draft plan stipulates production of 254.5 million tons of brown coal, 7.7 million tons of rolled steel, 96.8 billion kilowatt-hours of electricity, and the processing of nearly 20 million tons of crude oil and 11.7 billion cubic meters of natural gas. As in 1977, plans are to funnel 60% of 1978 investments into the production of raw materials, such as coal and potash mining, metallurgy, geologic exploration, and the chemical industry. The production of electricity in 1978 is planned to rise 5.2% over 1977 production to 96,750 million kilowatt-hours. Under the 1978 plan, the output of existing surface lignite mines is to increase by 6 million tons over 1977 output. Moreover, 35 million tons of raw brown coal is expected to be mined from surface mines that have been newly developed under the current 5-year plan.

Production of metallurgical products and rolled steel is planned to increase 4% from 1977 to 1978. Production in the chemical industry, which contributes 15% to overall industrial production, is planned to increase 6.7% during this period. Also during this period, industrial production in the glass and ceramics industries is planned to rise 6.9%.[10] Output forecasts under the 1978 economic plan are shown for the following products: City gas, 5,962 million cubic meters; oil processing, 19,950 thousand tons; finished rolled steel products, 4,519 thousand tons; other metallurgical products, 2,760 thousand tons; steel pipe, 448 thousand tons; cement, 12,500 thousand tons; potash fertilizer, 3,330 thousand tons (K_2O equivalent); and nitrogen fertilizer, 907,000 tons (nitrogen content).[11]

The 1978 plan also stresses production quality and conservation. For example, electrical energy consumption in 1978 is planned to be reduced 3%, compared with 1977 consumption; and savings in rolled steel for the same period are projected at 4.8% in the machine building industry and 3.7% in the construction industry. Consumption of cement is expected to fall 1.9% during the period.[12] The overall consumption of energy, raw materials, and other materials in industry is expected to be reduced 4% for 1978, compared with 1977 consumption.

PRODUCTION

Since most mineral statistics for the G.D.R. were not published, much of the production data in table 1 were estimated and represent at best an order of magnitude.

The metallurgical industry is one of the largest and most important sectors of the G.D.R. economy. Production of metallurgical products was valued at M13.2 billion in 1976; this was approximately 7.9% of the Nation's total industrial output. The metallurgical industry has overwhelmingly concentrated on production of ferrous metals; however, aluminum, tin, copper, zinc, lead, titanium, gallium, and selenium are also produced. With domestic iron ore deposits nearing depletion and production of nonferrous ores declining, the G.D.R. has a very weak mineral base for its metallurgical industry and can expand production only through increased imports of raw materials and scrap recycling. In carrying out its current 5-year plan, the G.D.R. is concentrating on production of higher quality steel, while relying on imports to meet domestic requirements for lower grades of steel.

The current 5-year plan envisions progressive enlargement of the metallurgical industry in order to support expansion of the G.D.R.'s important mechanical engineering industry. The plan emphasizes the use of indigenous sources and recycling to meet demand for metallurgical products. Under the plan, crude steel output is to be increased by 30% to 34%, and output of rolled steel is to be increased 39%. For nonferrous metals, the 5-year plan establishes a goal of expanding production of aluminum and tin while maintaining copper production at current levels. Plans are for investment to be concentrated in automation and modernization of existing plants, rather than in new capital construction.

The centers of the G.D.R. metallurgical industry are Eisenhuettenstadt, Brandenburg and Hennigsdorf, Riesa, Groeditz, Nordhausen, Karl-Marx-Stadt, Unterwell-

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enborn, Freiberg, Freital, and Aue. Of the 10 major metallurgical centers, all produce iron, steel, and associated products; and 4 also specialize in titanium, aluminum, gallium, nickel, selenium, tin, and zinc products.

According to Government reports, more than 160,000 workers are employed in the mining and metallurgical industry. In 1977, these workers fulfilled the prescribed annual production plan, including plans for the production of potash and lignite. Furthermore, production exceeded target levels by 30,000 tons for pig iron and by 20,000 tons for rolled steel. Industrial production of coal and energy in 1977 increased 4.8% over the previous year's production.[13] The G.D.R.'s economy in 1977 produced on a daily basis 700,000 tons of raw lignite, 21,000 tons of rolled steel, 31,000 tons of cement, 52,000 tons of petroleum, and 32 million cubic meters of natural gas.[14]

In 1977, the Ministry of Mining, Metallurgy, and Potash exceeded its production quotas by 6.4%, increasing production by 3.4% over the 1976 quota.[15] According to the head of the Ministry, workers conserved 170,000 tons of rolled steel annually in industry and construction, reduced annual consumption of rolled steel in metallurgy by 4.6%, and reduced consumption of nonferrous metals by 2.6%.[16]

Scrap and secondary raw materials are assuming a steadily growing significance in the G.D.R.'s raw materials base. Almost 75% of the G.D.R.'s crude steel and 70% of its copper are produced from secondary raw materials.[17] During the current 5-year plan, for example, the collection and utilization of ferrous and nonferrous metal scrap increased by 15%. Steel scrap is the most important raw materials base. In the production of steel and nonferrous metals in 1977, the G.D.R. utilized as much as 100% of the corresponding raw materials processing volume for each of these industries. In addition, the G.D.R.'s Minister of Geology stressed the use of ground slag from the Mansfeld complex as an additive in cement production, as well as the use of granitic and rhyolitic rocks as feldspar raw materials bases for the glass and ceramic industries, and the use of special gravels for the production of flint glass. Over 100 million tons of mineral raw materials is reportedly lost each year in mining, processing, and transportation, out of a total annual output of approximately 460 million tons.[18]

In 1977, the G.D.R.'s metallurgical industry employed about 130,000 workers, 22% of whom are women. The metallurgical industry comprises 7% of the Nation's total industrial production. Reportedly, workers in this sector produce a total output of over M15 billion per year.[19]

Table 1.—German Democratic Republic: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Aluminum:			
Alumina	48,300	44,468	38,953
Metal, primary[e]	r60,000	60,000	65,500
Cadmium metal, primary[e]	18	18	18
Copper:			
Mine output, metal content[e]	r16,500	r16,000	17,000
Smelter[e]	r16,500	r22,500	18,000
Refinery output including secondary	r47,000	r50,000	51,000
Iron and steel:			
Iron ore, gross weight[2] thousand tons	59	60	66
Pig iron do	2,456	2,528	2,628
Ferroalloys do	152	151	151
Crude steel do	6,472	6,732	6,850
Steel semimanufactures (including rolled and other products) do	4,281	4,593	4,802
Lead:			
Mine output, metal content[e]	4,000	4,000	--
Metal, refined, including secondary[e]	36,000	36,000	37,000
Nickel:			
Mine output, metal content[e]	2,400	2,500	2,500
Metal, refined[e]	2,600	2,800	2,800
Silver, mine output, metal content[e] thousand troy ounces	1,800	1,600	1,600
Tin:			
Mine output, metal content[e]	1,200	r1,300	1,400
Metal including secondary[e]	r1,300	r1,400	1,400
Zinc metal including secondary[e]	r15,200	r15,000	15,500
NONMETALS			
Barite[e]	31,000	31,000	31,000
Boron materials, processed borax, $Na_2B_4O_7.10H_2O$ content	3,367	4,000	e4,000
Cement, hydraulic thousand metric tons	10,657	11,344	12,102

See footnotes at end of table.

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Table 1.—German Democratic Republic: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]		1975	1976	1977[p]
NONMETALS —Continued				
Chalk[e]	thousand metric tons	50	50	50
Fertilizer materials, manufactured:				
Nitrogenous, N content:				
Ammonium sulfate	do	164	165	NA
Calcium ammonium sulfate	do	221	223	NA
Unspecified	do	153	388	NA
Total	do	538	776	839
Phosphatic, P_2O_5 content:				
Superphosphate	do	227	224	NA
Calcined phosphate	do	112	111	NA
Thomas slag	do	13	13	NA
Unspecified	do	75	75	NA
Total	do	427	423	403
Potassic, marketable potash, K_2O equivalent	do	3,019	3,161	3,229
Ammonia	do	1,117	1,361	1,374
Fluorspar[e]	do	90	90	100
Gypsum and anhydrite:				
Crude[e]	do	340	340	340
Calcined	do	306	302	304
Lime and dead-burned dolomite	do	3,030	3,404	[e]3,500
Pyrite, gross weight[e]	do	[r]25	25	25
Salt:				
Marine	do	51	52	53
Rock	do	2,380	2,508	2,590
Total	do	2,431	2,560	2,643
Sodium and potassium compounds, n.e.s.:				
Caustic soda		442,314	440,589	423,486
Sodium carbonate		818,208	828,998	839,561
Sodium sulfate		166,787	149,218	137,579
Stone, sand and gravel:				
Crushed stone	thousand tons	12,930	13,836	14,561
Sand and gravel	do	7,978	8,218	8,359
Sulfur byproduct:				
Elemental	do	85	79	[e]80
Other forms	do	[r]161	250	260
From pyrite[e]	do	10	10	10
Sulfuric acid	do	1,002	957	927
MINERAL FUELS AND RELATED MATERIALS				
Coal:				
Bituminous	do	539	457	349
Lignite	do	246,706	246,897	253,705
Total	do	247,245	247,354	254,054
Coke:				
From anthracite and bituminous coal	do	1,779	1,693	[e]1,600
From brown coal:				
High-temperature	do	2,041	2,123	2,240
Low-temperature	do	3,506	3,362	3,020
Total	do	5,547	5,485	5,260
Fuel briquets (from lignite)	do	48,938	48,679	48,749
Gas:				
Manufactured	million cubic feet	181,446	194,300	203,517
Natural, marketed production	do	[r]256,780	304,520	300,343
Petroleum:				
Crude[e]	thousand 42-gallon barrels	2,500	2,500	2,500
Refinery products:				
Gasoline	do	24,934	25,348	26,205
Kerosine, jet fuel, distillate fuel oil	do	36,884	38,823	41,048
Residual fuel oil	do	53,957	58,844	[e]63,000
Lubricants	do	2,579	2,666	2,738
Asphalt	do	6,311	6,596	7,268
Total[3]	do	124,665	132,277	140,259

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, magnesium, peat, and a variety of crude construction materials are produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2]Source indicates that data includes "roasted ore," presumably roasted pyrite.

[3]Total of listed products only; no estimates have been made for unreported products and/or refinery fuel and losses.

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TRADE

Detailed data on trade with individual countries or groups of countries are not reported in official G.D.R. statistics. The official 1977 trade book simply lists imports as follows: The socialist countries contributed 70%, the developing countries contributed 5%, and the "capitalist industrial countries" contributed 25%. Trade with the developing countries rose 15% over 1976 trade levels, totaling M4.5 billion. This trade was mainly with countries such as Algeria, Angola, Ethiopia, India, and Iran. Trade with developed market economy countries, however, declined 10% and totaled M21 billion. Countries in this category included Denmark, Finland, Sweden, the Federal Republic of Germany (F.R.G.), Holland, Austria, Japan, and the United States. Trade with the United States totaled M829 million.[20] Trade with the centrally planned economy countries in 1977 increased 14% over the previous year and totaled M65.5 billion. Trade with the Soviet Union increased 17% and totaled M32.5 billion. Trade between the G.D.R. and the F.R.G. rose only 3% over the previous year—to M8.7 billion—after expanding at an average annual rate of 8.4% from 1970 to 1976.[21]

Potash continued to be one of the G.D.R.'s major export commodities in 1977, and was purchased by India and Brazil, as well as by the centrally planned economy countries. Brown-coal briquettes and rock salt were two other main mineral export commodities.

Most of the G.D.R.'s imports come from the centrally planned economy countries, primarily from the Soviet Union, which supplies 36% of the G.D.R.'s imports. Crude oil and natural gas are imported mostly from the Soviet Union, but also from Syria, Iraq, and Egypt. The planned extension of the Friendship (Druzhba) natural gas pipeline from Orenburg, U.S.S.R., into the G.D.R. is expected to result in further gas imports. The import of hard coal from the Soviet Union declined in 1977. Since 1950, the G.D.R. has received from the Soviet Union more than 170 million tons of petroleum, more than 55 million tons of iron ore, and 47 million tons of rolled steel. Bituminous coal and sulfur are imported from Poland; bituminous coal, coke, and rolled steel are shipped from Czechoslovakia, and bauxite and clay are imported from Hungary. Aluminum and titanium oxide are imported from Yugoslavia, and imports of copper and zinc from that country are planned to begin in 1979. Nickel is expected to be imported from Cuba during the next 5-year plan.[22]

In 1977, total imports of M49.8 billion were 9% higher than in 1976, but total exports rose only 6% to M41.8 billion. Despite a considerable effort, the G.D.R. did not succeed in preventing an increased trade deficit in 1977.[23] The 1977 foreign trade turnover increased 7% to M91.6 billion. Plans for 1978 envisage an 11% increase in the trade turnover. Foreign trade, however, will probably continue to place a strain on the economy because prices of raw materials are expected to rise further. The 1978 import-export pattern is expected to be the same as in 1977. 1978 exports are planned to consist of machines and equipment (51%); fuels, mineral raw materials, and metals (11%); semifinished products (10%); and chemical products, fertilizers, and building materials (14%). Imports are also expected to consist of machines and equipment (32%); fuels, mineral raw materials, and metals (30%); semifinished products (25%); and chemical products, fertilizers, and building materials (10%).[24] The country's main import commodities in 1978 are projected to be about 18 million tons of oil, 2 million tons of iron ore, 700,000 tons of asbestos, and more than 25,000 tons of titanium oxide.

According to the 5-year plan (1976-80) agreement, the G.D.R. is to import from the Soviet Union over the 5-year period 88.2 million tons of crude oil, 216 billion cubic meters of natural gas, 21 million tons of bituminous coal, 15.9 million tons of rolled steel, and 212,000 tons of copper. In 1978, the G.D.R. expects to receive from the Soviet Union 17.7 million tons of crude oil, 3.7 billion cubic meters of natural gas, 2.95 million tons of rolled steel, 1.36 million tons of iron ore, as well as large quantities of nonferrous metals, asbestos, and other raw materials.[25]

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Table 2.—German Democratic Republic: Exports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal including alloys:			
Scrap	855	3,470	United Kingdom 1,232; Netherlands 808; France 754.
Unwrought	1,098	1,376	United Kingdom 607; Belgium-Luxembourg 372.
Semimanufactures	2,460	1,299	Hungary 1,002; Poland 242.
Copper metal including alloys:			
Scrap	130	59	All to Italy.
Unwrought	153	601	Austria 250; Italy 176; United Kingdom 175.
Semimanufactures	34	292	Poland 200; Austria 86.
Iron and steel metal:			
Scrap, thousand tons	29	17	Austria 10; Spain 2; United Kingdom 2.
Pig iron, do.	155	95	Sweden 50; Yugoslavia 24.
Ferroalloys, do.	NA	3	NA.
Steel, primary forms[2], do.	r506	471	Belgium-Luxembourg 138; Yugoslavia 77; Italy 45.
Semimanufactures:			
Bars, rods, angles, shapes, sections[2], do.	398	400	NA.
Plates and sheets, do.	2286	2289	Poland 43; West Germany 38;[3] Italy 33; France 19.
Hoop and strip[2], do.	161	128	NA.
Rails and accessories[2], do.	7	12	NA.
Wire[2], do.	23	50	NA.
Tubes, pipes, fittings, do.	2136	2140	Yugoslavia 21; France 14.
Castings and forgings, do.	222	221	Poland 13.
Total, do.	r1,033	1,040	
Lead:			
Oxide	926	810	France 378; Sweden 210; Denmark 162.
Metal including alloys, unwrought	2,053	1,313	Austria 1,073.
Nickel metal including alloys, unwrought	242	229	Netherlands 174; United Kingdom 33.
Silver metal, all forms, value, thousands	$202	$14,356	All to United Kingdom.
Tin metal, all forms (including alloys)	NA	186	Do.
Zinc:			
Oxides	2,205	2,857	Norway 1,636; France 400; Sweden 334.
Metal including alloys, scrap	1,886	880	France 391; Belgium-Luxembourg 287.
Other:			
Ash and residues containing nonferrous metals	17,677	13,302	Spain 12,459.
Base metals including alloys	NA	40	Netherlands 35.
NONMETALS			
Abrasives, grinding and polishing stones	56	46	Greece 26; Italy 20.
Barite	240	10,052	All to Poland.
Cement, thousand tons	132	260	Hungary 199; Poland 60.
Chalk[3]	42,995	48,765	NA.
Clays and clay products:			
Crude clays:			
Kaolin[3]	95,443	108,260	NA.
Other	NA	3,046	Poland 2,546; Hungary 500.
Products:			
Refractory	4,759	8,787	Poland 5,528; Sweden 1,654; Norway 761.
Nonrefractory	7,266	5,778	Belgium-Luxembourg 1,865; Denmark 1,258; Yugoslavia 1,002.
Diamond:			
Gem, not set or strung, value, thousands	--	$168	All to United Kingdom.
Industrial, do.	NA	$363	Belgium-Luxembourg $345.
Feldspar and fluorspar	9,985	42,063	Poland 19,808; Austria 8,354; Norway 8,093.
Fertilizer materials:			
Nitrogenous, manufactured	NA	3,430	All to United Kingdom.
Potassic, crude and manufactured, (K_2O content)[3], thousand tons	2,252	2,428	Czechoslovakia 496; Poland 479; Hungary 267.
Other including mixed	--	560	Denmark 320; Sweden 180.
Ammonia, thousand tons	120	87	Denmark 44; Sweden 17; Yugoslavia 12; Poland 10.
Gypsum, calcined	364,471	376,730	Hungary 29; Czechoslovakia 25.
Magnesite	--	600	All to United Kingdom.
Pigment, natural, crude	--	176	All to Hungary.
Salt[3], thousand tons	945	1,102	Sweden 82; Finland 55; Norway 36.
Sodium and potassium compounds:			
Caustic soda	6,806	4,430	All to Hungary.
Caustic potash	8,842	3,785	U.S.S.R. 1,200; Hungary 1,129; Switzerland 551.

See footnotes at end of table.

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Table 2.—German Democratic Republic: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Sodium and potassium compounds —Continued			
Soda ash (Na_2CO_3 content)__ thousand tons__	r [3]272	[3]296	Hungary 20; Finland 19;[3] Sweden 18.
Stone and sand and gravel:			
Dimension stone	487	967	Norway 499; Denmark 166; Netherlands 154.
Gravel and crushed rock[3]	r350,321	392,076	NA.
Sand, excluding metal bearing	12,000	28,446	Yugoslavia 19,353; Austria 9,093.
Sulfur and sulfuric acid	r [3]38,438	[3]35,031	Yugoslavia 6,012.
Other:			
Oxides of strontium, barium, magnesium	475	622	Sweden 502.
Halogens	--	63	All to Italy.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	[3]8,400	5,064	United Kingdom 1,380; Bulgaria 1,161; Czechoslovakia 1,127.
Coal, lignite briquets[3] thousand tons__	2,286	2,287	West Germany 945; Czechoslovakia 459; Austria 194.
Coke do.	2	63	Spain 29; Netherlands 24.
Gas, manufactured million cubic feet__	1,303	622	Mostly to Netherlands.
Petroleum refinery products:			
Gasoline[3] thousand 42-gallon barrels__	4,110	3,537	NA.
Distillate fuel oil[3] do.	7,066	10,621	NA.
Residual fuel oil do.	2,017	1,896	Austria 1,264.
Lubricants do.	36	33	Austria 16.
Other:			
Liquefied petroleum gas do.	NA	58	All to Hungary.
Mineral jelly and wax do.	403	105	West Germany 33;[3] Netherlands 16; France 15.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	3,428	2,451	Switzerland 1,452; France 665.

rRevised. NA Not available.

[1]Unless otherwise specified, data are partially or wholly compiled from the 1976 edition of the United Nations Supplement to the World Trade Annual, v. I, as well as from official trade statistics of Bulgaria, Czechoslovakia, Hungary, Poland, and the U.S.S.R.

[2]Source: Quarterly Bulletin of Steel Statistics for Europe (1977 edition). United Nations. 1977.

[3]Source: Official Trade Statistics of the German Democratic Republic.

Table 3.—German Democratic Republic: Imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite[2] thousand tons__	265	261	Hungary 190; Yugoslavia 71.
Alumina, Al_2O_3 content	94,524	89,504	West Germany 61,305;[2] Hungary 28,123.
Metal including alloys:			
Unwrought	160,192	[3]51,641	Yugoslavia 44,213; Hungary 7,428.
Semimanufactures	[2]45,800	[3]12,474	Hungary 6,856; Yugoslavia 4,719.
Chromium (chromite, Cr_2O_3 content)	[2]58,300	[2]48,600	U.S.S.R. 27,000.
Copper:			
Ore and concentrate	16,239	26,048	Sweden 21,248; Norway 4,800.
Metal including alloys:			
Scrap	569	634	Switzerland 284; Netherlands 172; Belgium-Luxembourg 148.
Unwrought	502	12,245	Poland 8,106; Sweden 2,580; Finland 1,120.
Semimanufactures	403	1,784	Poland 1,255; Austria 335.
Iron and steel:			
Ore and concentrate, Fe content thousand tons__	[2]2,118	[2]2,053	U.S.S.R. 1,355; India 127.[2]
Metal:			
Scrap	[2]22,565	515,020	U.S.S.R. 511,281.
Pig iron thousand tons__	[2]782	[2]628	Mostly from U.S.S.R.
Ferroalloys do.	[2]24	[4]27	U.S.S.R. 11.
Steel, primary forms do.	r1,618	[4]1,660	NA.
Semimanufactures:			
Bars and rods[2] do.	598	601	U.S.S.R. 397; Czechoslovakia 81.

See footnotes at end of table.

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Table 3.—German Democratic Republic: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Iron and steel —Continued			
Metal —Continued			
Semimanufactures —Continued			
Plates, shapes, rails, accessories thousand tons	508	460	U.S.S.R. 315.
Heavy plates[2] do	492	615	NA.
Light plates and sheets[2] do	75	76	NA.
Pipes[2] do	333	615	U.S.S.R. 499.
Castings and forgings[4] do	11	11	NA.
Lead:			
Oxide	1,016	2,808	All from Austria.
Metal, unwrought and semimanufactures	47,009	[3]375	All from United Kingdom.
Manganese:			
Ore and concentrate (Mn content)[2] thousand tons	179	80	All from U.S.S.R.
Metal, all forms	--	91	All from France.
Mercury 76-pound flasks	12,125	2,698	All from Italy.
Molybdenum metal, all forms	--	1	All from Austria.
Nickel:			
Ore and concentrate	--	75	All from France.
Metal, all forms	59	227	Finland 90; United Kingdom 54; Austria 50.
Silver, unworked or partly worked value, thousands	$10,600	[5]$22,268	All from United Kingdom.
Tin metal, all forms (including alloys)	99	823	Sweden 703; United Kingdom 120.
Titanium oxide	13,239	16,171	Yugoslavia 11,849; Finland 4,322.[2]
Tungsten metal, all forms	6	4	All from Austria.
Zinc metal including alloys, all forms	49,998	[3]13,727	Finland 7,493; Australia 6,000.
Other:			
Ore and concentrate	222	4,968	Norway 4,243; Netherlands 688.
Metals including alloys:			
Metalloids value, thousands	$1,022	$2,899	Sweden $2,311.
Base metals, n.e.s	482	1,141	Japan 859; United Kingdom 193.
Nonferrous metals including alloys:[3]			
Unwrought	--	251,672	All from U.S.S.R.
Semimanufactures	--	17,750	Do.
NONMETALS			
Abrasives:			
Dust and powder of precious and semiprecious stones, except diamond value, thousands	NA	$31	Belgium-Luxembourg 27.
Grinding and polishing stones	144	87	Austria 77.
Asbestos[2]	65,725	58,000	Mostly from U.S.S.R.
Boron oxide and acid	--	3,138	France 3,038.
Cement thousand tons	[2]41	47	U.S.S.R. 42; Poland 5.
Clays and clay products:			
Crude clays:			
Bentonite	16,876	15,425	All from Hungary.
Kaolin[2]	32,128	27,800	United Kingdom 15,133.
Fire clay	NA	7,296	All from Poland.
Products:			
Refractory	NA	5,023	United Kingdom 2,668; France 954; Austria 591.
Nonrefractory	6,370	1,196	Austria 684; Yugoslavia 354.
Diamond, industrial value, thousands	$1,685	$2,207	Belgium-Luxembourg $1,793; Netherlands $414.
Feldspar and fluorspar	28,616	17,887	Norway 14,330; Sweden 2,514.
Fertilizer materials:			
Crude, phosphatic (P_2O_5 content)[2] thousand tons	510	518	U.S.S.R. 477.
Manufactured:			
Nitrogenous do	[2] [6]112	27	Poland 23; France 4.
Phosphatic (P_2O_5 content)[2] do	32	49	West Germany 21; Sweden 8.
Ammonia	NA	11,450	All from Hungary.
Graphite[2]	5,216	5,553	NA.
Magnesite, all forms thousands tons	52	35	Czechoslovakia 31;[2] Greece 3.
Mica, all forms[2]	2,250	2,779	India 806.
Pigments (processed iron oxides)	375	343	France 188; Italy 125.
Pyrite thousand tons	118	150	U.S.S.R. 127; Spain 23.
Stone, sand and gravel	14,907	1,332	Yugoslavia 1,255.
Sulfur:			
Elemental, all forms	[2]146,000	163,500	All from Poland.[2]
Sulfuric acid	36,218	24,674	Poland 20,560; Switzerland 2,758.
Talc	1,509	1,464	All from Austria.
Other: Slag, dross, similar waste	48,284	19,428	All from Sweden.

See footnotes at end of table.

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Table 3.—German Democratic Republic: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	[2]23,605	26,528	U.S.S.R. 26,162.
Coal:			
Anthracite and bituminous[2] thousand tons	3,964	6,096	U.S.S.R. 4,083; Poland 1,266; Czechoslovakia 593.
Lignite ---do---	3,434	3,078	All from Poland.
Coke[2] ---do---	2,971	2,917	U.S.S.R. 1,085; Poland 775; Czechoslovakia 751.
Gas, natural[2] million cubic feet	113,914	118,675	All from U.S.S.R.
Petroleum:			
Crude[2] thousand 42-gallon barrels	124,928	132,651	U.S.S.R. 117,688; Iraq 11,746.
Refinery products:			
Gasoline ---do---	NA	6	Yugoslavia 5.
Kerosine ---do---	8	277	Denmark 265.
Lubricants ---do---	1	4	United Kingdom 2.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	63,220	48,571	U.S.S.R. 46,159.

[r]Revised. NA Not available.

[1]Unless otherwise specified, data are partially or wholly compiled from the 1976 edition of the United Nations Supplement to the World Trade Annual, v. I, as well as from official trade statistics, of Bulgaria, Czechoslovakia, Hungary, Poland, and the U.S.S.R.

[2]Source: Official Trade Statistics of the German Democratic Republic.

[3]Individual commodity totals for 1976 and data and distribution by trading partners exclude figures for the U.S.S.R., which were not categorized by individual metals, but rather are reported in two categories listed at the end of the metals section as "Nonferrous metals including alloys: Unwrought and semimanufactures."

[4]Source: Quarterly Bulletin of Steel Statistics for Europe (1977 edition). United Nations. New York. 1977.

[5]Total excludes 96,000 troy ounces of unknown value imported from Poland.

[6]Total import of nitrogenous fertilizer is expressed in N content.

COMMODITY REVIEW

METALS

Aluminum.—Estimated domestic production of primary aluminum in 1977 totaled 65,000 tons. Large quantities of the country's 1977 aluminum consumption were imported from the U.S.S.R. The G.D.R.'s estimated consumption of aluminum rose from 210,000 tons in 1976 to 215,000 tons in 1977.[28]

Imports of aluminum from Western countries fell drastically in 1977 to 1,600 tons, compared with 44,200 tons in 1976. The G.D.R.'s remaining aluminum imports came from the U.S.S.R. The G.D.R. in 1977 imported 396 tons of aluminum alloys. Its exports of aluminum to Western countries, however, increased 51% in 1977 to 20,400 tons. 1977 exports to the F.R.G. increased 64% over 1976 exports to 19,867 tons. Exports of unwrought aluminum to the United Kingdom declined in 1977 to only 70 tons, compared with 607 tons in 1976, but imports from the United Kingdom rose to 339 tons, compared with only 30 tons in 1976. Exports of aluminum and aluminum alloys to the Netherlands in 1977 totaled 24 metric tons, and imports also totaled 24 tons. Imports of aluminum from Norway totaled 1,005 tons. Japan in 1977 imported 396 tons of aluminum alloys from the G.D.R.

Primary aluminum is produced at two plants, the Electrochemisches Kombinat at Bitterfeld (55,000 tons annual capacity) and the Electrochemisches Kombinat (Lauta Werke) at Lauta (30,000 tons annual capacity). The G.D.R.'s only alumina plant (70,000 tons annual capacity) is also located at Lauta. The G.D.R. does not have any indigenous bauxite deposits and imports all of its bauxite from Hungary and Yugoslavia.

The introduction in 1976 of continuous cast rolling of aluminum at the Nachterstedt Light Metal Works resulted in increased work productivity in 1977 and a rise in product quality. This innovation was introduced with aid from the Soviet Union. An energy saving of 300 kilowatt-hour per ton was reported as a result of the renovation.[27]

Cadmium.—The estimated production of cadmium remained the same in 1977 as in 1976, at 18 metric tons, but 1977 consumption dropped 10 tons to 450 tons. All of the G.D.R.'s requirements for cadmium are met by imports from the U.S.S.R. Cadmium is obtained as a smelting byproduct at the

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VEB Mansfeld Kombinat Wilhelm Pieck plant at Eisleben and the Electro works at Weida, Thuringia.

Copper.—Production of refined copper was estimated at 51,000 tons in 1977, but has virtually come to a standstill since 1975. The estimated consumption of refined copper dropped from 118,000 tons in 1976 to 115,000 tons in 1977. The only producing copper mines during the year were near Sangerhausen. Deposits at Mansfeld-Eisleben-Hettstedt are almost depleted and the mines have been closed since 1974.

In 1977, the G.D.R. exported 8,123 metric tons of unwrought copper to the F.R.G; this reflected a slight decline in copper exports to that country since 1976. Imports of unwrought copper and semimanufactures from the F.R.G., however, increased 145% to 30,762 metric tons. Most of the G.D.R.'s imported copper in 1977, as in previous years, came from the Soviet Union. Other 1977 imports came from Chile (1,400 tons of electrolytic copper) and Peru (10,516 tons of refined copper). Copper exports from the G.D.R. went to Belgium-Luxembourg (2,634 tons of refined copper) and Italy (996 tons of copper, alloys, and semimanufactures), in addition to the F.R.G.

Construction of a copper drawing and rolling mill at the copper and silver works in Hettstedt, a part of the Mansfeld combine, was completed in 1977. The new mill occupies a space of 4,000 square meters. Most of the equipment and technical labor used to build the mill was supplied by the Soviet Union. Full production is expected to start late in 1979.

Iron and Steel.—The G.D.R.'s iron mining industry is old, and now most of its iron ore resources are nearly depleted and production figures are no longer reported. The production of steel and pig iron is also inadequate to meet domestic demand and therefore the G.D.R. depends heavily on imports to meet its requirements for these commodities. The Soviet Union is practically the sole supplier of pig iron and rolled steel to the G.D.R. Nevertheless, the G.D.R. exported 1,654,000 tons of semifinished and finished steel in 1977.

Iron ore deposits of the G.D.R. are of four types: (1) the hydrothermal-metasomatic siderite and limonite ores of the post-Variscan (Kimmeridgian) age related to the marginal faults of the Thuringian Forest area, (2) the volcanic-sedimentary deposits of the Devonian age in the Thuringian and the Harz Mountains, (3) the marine-sedimentary iron ores of the Ordovician age in Thuringia and of the Jurassic and Cretaceous ages in the area north of the Harz Mountains, and (4) the Skarn iron ores of contact-metamorphic origin related to Variscan granite in the Erzgebirge. Of these types, only the Devonian volcanic-sedimentary deposits and the Ordovician and Jurassic marine-sedimentary deposits have had economic importance.

About 75% of the G.D.R.'s steel production is made from scrap. The production of crude steel is targeted at 7.5 million tons for 1980. Production of special corrosion-resistant steels began in the G.D.R. about 10 years ago and has now reached 60,800 to 70,000 tons annual output. The production of superhard welding and stainless steels increased more than 20% from 1976 to 1977. Production of stainless steel is anticipated to rise 50% by 1980, compared to production for 1970.

The methods of crude steel production in the G.D.R. remained the same in 1977 as in the previous year. Most of the steel, or 69%, was produced by the open-hearth method; 21% was produced in electric furnaces; oxygen was used to produce 9%; and other methods were used for the remaining 1% of production. In 1977, the G.D.R. expanded its production of semifinished steel, primarily through the utilization of electric furnaces in combination with continuous casting.[28]

The recent reconstruction of the Wilhelm Florin steel and rolling mill of the Henningsdorf complex contributed to a production increase of 39% in 1977, compared with production for 1976. In 1977, the Henningsdorf steel and rolling mills complex, which is the main producer of reinforcing rods, modernized its Konti-Five steel plant. In 1977, it produced about 180,000 tons of rolled steel and plans to produce 400,000 tons in 1978. The completed second stage of the continuous thin-sheet rolling mill at Henningsdorf also contributed to increased 1977 production of all rolled steel products.

In 1977, the entire Maxhütte steel mill at Unterwellenborn was renovated, thus increasing production of block steel by 58%. The Siemens-Martin furnace at the Brandenburg steel and rolling mill began operating in 1977, raising steel production by 2,000 tons more than 1976 production. The mill continued to be the largest producer of crude steel in the G.D.R.[29]

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Reportedly, the G.D.R. negotiated a contract at the 1977 spring fair in Leipzig with the Italian firm Danieli & Co. for construction of a steelworks at Brandenburg with two electric arc furnaces and continuous casting. Capacity is expected to be 550,000 tons per year and the plant is expected to be completed by 1980.[30] A new plant was also commissioned at Finow for the production of light steel sections.

Of the 1.5 million assorted castings manufactured annually in the G.D.R., most are being made of cast iron that has had spherical graphite added to it. In 1977, the old furnace at the Torgelow combine was being replaced by a 4-ton electric furnace for the production of high-quality castings. An experimental foundry was being constructed at Lobenstein that will be equipped with induction-type smelting furnaces. Another foundry near Uckermünde on the Oder estuary was under construction and was expected to be completed in 1978.

The Bandstahlkombinat Herman Mattern in Eisenhuettenstadt Ost is reportedly planning to increase its production of cold-rolled sheets to 14.5 million tons per year by 1980. The plant's production of galvanized products is also expected to increase from 160,000 tons in 1977 to 206,000 tons by 1980. The Bandstahlkombinat also plans to install a pickling line for coils 2 to 6 millimeters thick and up to 1.85 meters wide, increase annealing facilities, and expand slitting and cut-to-length capacities.

Lead and Zinc.—The production of lead and zinc is fluctuating and the G.D.R.'s mine output of zinc has virtually ceased due to depletion of ore. The G.D.R.'s lead and zinc deposits are found in the vicinity of Freiberg in a low-grade complex of polymetallic ores that contain lead, zinc, silver, pyrite, and fluorspar in thin beds. The ores are concentrated by flotation in two plants at Freiberg.

The 1977 estimated consumption of lead, despite indigenous ore depletion, increased 2% over 1976 consumption to 95,000 metric tons. Zinc consumption increased 5% to 68,000 tons. The production of refined lead in 1977 was estimated at 37,000 tons and zinc production was estimated at 15,500 tons.

In 1977, the G.D.R. reportedly imported 5,900 metric tons of lead from Belgium-Luxembourg, 919 tons from Austria, 250 tons from Mexico, and 500 tons from Peru. Some 1,000 tons of zinc was imported from Norway and 2,000 tons came from Australia. Most of the G.D.R.'s lead and zinc is imported from the Soviet Union. Imports of zinc from Western countries in 1977 dropped off 46% from 1976 levels, to 8,500 tons. The G.D.R. exported 980 tons of refined lead during the year to Western countries, a drop of 25% from the previous year's lead exports.

Nickel.—The G.D.R.'s nickel industry is centered at the Aue (St. Egidien) nickel plant. The estimated 1977 production of refined nickel in the G.D.R. was 2,800 tons. Consumption of nickel went up slightly, from 10,000 tons in 1976 to 10,500 tons in 1977.

Silver.—Silver is mined in the G.D.R. as a byproduct. The estimated primary silver production in 1977 was unchanged from the previous year's production, at 50 metric tons (1,600,000 troy ounces).

The G.D.R.'s annual requirement of about 500 tons of silver reportedly came from three sources: (1) ore extraction, which is in decline because of increasing mining costs and diminishing domestic deposits; (2) increased imports from Western countries resulting from decreasing deliveries from the CMEA countries (85% of the G.D.R.'s imported silver is purchased with convertible currencies on the London Metals Exchange); and (3) recovery of silver from secondary raw materials and waste, sources that accounted for 25% of the G.D.R.'s 1977 silver output. According to one report, the G.D.R. presently produces 22 tons of silver through fixing-bath reduction.[31]

Tin.—More than 50% of tin requirements are imported from market economy countries. The G.D.R.'s tin deposits are low grade and located in the Erzgebirge along the country's southeastern border. Tin ore is mined at Altenberg, Sadisdorf, and Ehrenfriedensdorf. The ore contains from 0.20% to 0.35% tin and is beneficiated by gravity concentration to a product that is approximately 40% tin. Consumption of tin in the G.D.R. remained almost the same in 1977 as it was in 1976, at 2,700 tons. In 1977, the G.D.R. imported 12,600 tons of tin plate from the Soviet Union, reflecting a decrease of 4,500 tons from the previous year's imports from that country.

According to the current 5-year-plan target, tin production is to increase 45% by 1980, and production costs are planned to go down by 12% per ton.[32] According to the Ministry of Foreign Trade, the G.D.R. pos-

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sesses sufficient deposits of tin ore to increase production as planned and to meet the country's growing demand for tin.

A newly developed mine and a new tin ore processing plant were completed in 1977 at Altenberg in the Dresden area. The new unit will make it possible for the G.D.R. to expand the production of both ore and tin concentrate according to plans. The tin concentrate from Altenberg is expected to be processed at the Freiberg plant.

The new tin smelter at Freiberg also contributed significantly to an increase in tin recovery from domestic sources. In 1977, the Albert Funk mining and metallurgical complex in Freiberg (Bezirk Karl-Marx-Stadt) expanded production. Equipment for the new tin smelter, which is part of the Albert Funk complex, was provided by the Soviet Union, and Soviet experts helped assemble the smelter.[33]

NONMETALS

Barite and Fluorite.—The 1977 estimated output of barite remained the same as in 1976 at 31,000 tons. Barite is processed at the Lengenfeld fluorite and barite plant in the southern part of the country. The estimated 1977 production of fluorite was 100,000 tons, mined principally from the Harz Mountains and the Thuringian Forest region.[34] The exploration depth for fluorite is expected to go from the present depth of 600 meters to 1,000 meters in 1979.

Cement.—There were approximately 32 cement plants spread throughout the G.D.R. in 1977, with the densest concentration in the south. The largest plant is the Karsdorf cement works near Halle; its 1977 estimated annual kiln capacity of 4.1 million tons is expected to increase to 4.3 million tons in 1978. The other five major cement works are Rüdersdorf (2.8-million-ton capacity), Bernburg (2.7-million-ton capacity, including the Dessau works), Deuna (2.0-million-ton capacity), Bitterfeld (200,000-ton capacity), and Pisterlitz (200,000-ton capacity). The Halle district produces 25% of all the G.D.R.'s building materials.

The Karsdorf cement works introduced production of a new sulfate-resistant cement in 1977, with full production slated to begin in January 1978. All of the G.D.R.'s cement plants are managed by VEB Zementkombinat, with headquarters located in Donau. The 12.1-million-ton production of 1977 is expected to rise to 12.5 million tons in 1978 and to 13.0 million tons in 1979. The cement industry employed about 15,000 workers in 1977.[35]

Chalk.—The 1977 estimate of the G.D.R.'s chalk production remains the same as in 1976, at 50,000 tons. Chalk is mined on Rügen Island near Sassnitz, Europe's largest deposit of compact chalk. About 30% of the domestic chalk production is exported.

Clays.—New clay quarries are being opened and production is being upgraded. The country's richest kaolin deposits are near Bautzen, and the major kaolin works are located at Cominau, Salzmünde, Spergau, and Kemmlitz. Bentonite is imported from Hungary. Kaolin is imported from Hungary and Czechoslovakia, but the G.D.R. also exports kaolin.

The G.D.R.'s Ministry of Glass and Ceramics Industry employs approximately 20,000 workers, and 15,000 of these workers are engaged in the production of technical glass. The technical glassworks in Ilmenau was under construction in 1977. Forty mining enterprises of the glass and ceramic ministry are reportedly upgrading their output of kaolin, glass sand, glass lime, and quartzite so that plans to increase production by 25% between 1979 and 1980 can be realized. Production of these materials is currently estimated at 3 million tons annually.[36]

Fertilizer Material.—The G.D.R.'s total fertilizer production in 1976 reached 4.5 million tons of nutrients, reflecting a slight increase of 2% over the previous year's output. This production was made up of potassium (K_2O) fertilizers (72%), nitrogen fertilizers (19%), and phosphorous (P_2O_5) fertilizers (9%).

Nitrogen.—Production of nitrogen fertilizers in 1977 increased to a total of 839,000 tons (nitrogen content), reflecting an 8% increase over the previous year's production. The increased production is due mainly to the operation of three new units of the VEB Stickstoffwerk Piesteritz. The G.D.R.'s nitrogen fertilizer production is centered near Leipzig, with one important plant located at Schwedt near the Polish border. The G.D.R. imports and exports small quantities of nitrogen.

Phosphate.—The production of phosphatic fertilizers (in terms of P_2O_5 content) in the G.D.R. fluctuates and was 403,000 tons in 1977, reflecting a decrease of 5% over the previous year's production. The G.D.R. exports insignificant amounts of its phosphatic fertilizers but imports large quantities of

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raw phosphate and apatite concentrates and some manufactured fertilizers. In 1977, a total of 1,491,000 tons of phosphate rock was imported, of which 1,200,000 tons of apatite concentrate came from the Soviet Union, 171,000 tons of phosphatic rock came from Morocco, and 120,000 tons of phosphatic rock came from Tunisia. Several marine phosphorite horizons of the Middle Oligocene age have been found around Leipzig. The deposits occur as sandy concretions and as fossilized organic remains.

Potassium.—In 1977, the G.D.R. remained the world's third largest producer of potash. Production rose to a record high of 3.2 million metric tons of K_2O in 1977, an amount in excess of the planned target. The 1978 planned production target is 3.34 million tons of potash. It is estimated that the G.D.R. will produce 4 million tons of potash in 1980. Present identified reserves are estimated at 300 to 900 million tons of K_2O, and total reserves are estimated at 5 to 7 billion tons.[37]

All potash enterprises are subordinate to the VEB Kombinat Kali, and the industry is divided into four groups, the Kalibetrieb Werra, the Kalibetrieb Süd Harz, the Kali und Steinzalzbetrieb Saale, and the Kalibetrieb Zielitz. Each group is responsible for the operation of its own mines. The Kalibetrieb Zielitz operates the G.D.R.'s newest mine at Wolmirstedt and is the country's largest potash producer, with an estimated annual capacity of 1.1 million tons of K_2O. The three mines at Werra near Eisenach are the country's largest potash-producing mines, with combined annual capacity estimated at 1.4 million tons. The other major potash mines are, in descending order by production, the Bischofferode mine at Erfurt (250,000 tons annual capacity), Rossleben at Halle (200,000 tons), Sondersshausen at Erfurt (150,000 tons), Bleicherode at Erfurt (150,000 tons), Sollstedt at Erfurt (120,000 tons), Menteroda at Erfurt (120,000 tons), and Teuschenthal at Halle (30,000 tons).

The Minister of Mining, Metallurgy, and Potash emphasized in 1977 that increased production of mineral fertilizer in the potash industry must be achieved not only through intensified production from existing potash plants, but also from the mining and processing of new types of crude salt. He stressed, for example, increased processing of carnallite, a type of crude salt. However, this would require the development of a completely new technology for carnallite extraction and processing, and would require strict environmental controls.[38] By 1977, more than 50,000 hectares of land that was once mined for potash had been restored to cultivation; of this restored land, 30% is used for crop farming.

Minable potash deposits in the G.D.R. are concentrated in five beds that comprise a mixture of different potash ores, such as sylvinite, carnallite, and hartsalz. Of the four regions where potash is mined, the Werra region, where the Merker center is located, is the most important. In the Werra Fulda Valley, in the southern Harz area, the Zechstein potash deposits are mined at 11 mines. Since the recent opening of the Zielitz mine, potash is also mined on the North German Plain. The two potash beds of the Werra Fulda Valley are nearly horizontal, but in places they are strongly disturbed with vertical displacements of up to 8 meters. The carnallite ore, containing from 12% to 15% K_2O, is mined 800 meters below the surface, using the room-and-pillar method that is common to all potash mining in the G.D.R. Mining is complicated, however, by the high gas content of the ore and by overlying water-saturated strata. The southern Harz mines are between 400 and 1,000 meters deep. The ore mined from these mines is mainly harzsalz averaging from 12% to 15% K_2O, but because of difficult roof conditions, only 30% to 34% of this ore is recovered. At the Zielitz mine on the North German Plain, potash is mined at a depth of 700 to 800 meters from a sylvinite bed 6 to 9 meters thick with a uniform slope of 18 to 25° and an average K_2O content of 15%.[39]

In 1977, a new plant for the production of high-grade potash fertilizer was being constructed in the Suhl area as part of the Werra potash enterprise of Merkers/Rhoen, the country's largest producer. This new factory is the second largest investment project of the G.D.R.'s potash industry and is planned to upgrade the present obsolete plant. More than 8,000 workers are employed by the Werra enterprise, and 30,000 workers are employed in the entire potash industry.

MINERAL FUELS

It was reported that the coal and energy industry of the G.D.R. fulfilled its 1977 production plan. Approximately 69% of the G.D.R.'s total energy requirements are satisfied by lignite and lignite is used to

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produce 83% of the country's electrical energy. Daily consumption of lignite in the G.D.R. amounts to 690,000 tons plus 109,000 tons of lignite briquets. Sources for the generation of electrical energy in the G.D.R. in 1977 were as follows: Of the total 92 billion kilowatt-hours of electricity that was produced, 83.3% was produced from raw lignite; 0.9% from lignite briquets; 0.6% from bituminous coal; 1.4% from hydraulic power; 5% from nuclear energy; 3% from oil; and the remainder from other fuels, including natural gas. With the exception of the Greifswald nuclear powerplant, all major plants in the G.D.R. use lignite as the primary source of energy.[40]

Production in excess of national quotas for 1977 was reported at 175 million cubic meters for gas, 6.5 million tons for lignite, and 1.1 million tons for lignite briquets. In order to meet the increasing demand for lignite, 7 new mines are to be opened during the current 5-year plan period. About 60% of industrial investments in 1977 were used for the expansion of domestic energy and raw materials bases. Almost 75% of the total annual yield of 254 million tons of lignite is used by the Nation's approximately 80 power stations for the generation of electricity and heat. The G.D.R. provides 70% of its own energy raw materials requirements.[41]

The total capacity of the G.D.R.'s power stations reportedly amounted to 16,928 megawatts in 1975. In 1977, a total of 92 billion kilowatt-hours of electrical energy was produced. New large-scale thermal power stations have been equipped with block units produced in the Soviet Union. These units have a capacity of 210 or 500 megawatts each, and it is anticipated that more will be received from the Soviet Union.

According to some reports, the G.D.R. still uses the highest amount of electricity per inhabitant (5,015 kilowatt-hours in 1975), of all other CMEA countries, in spite of some successes in energy conservation. The G.D.R. also uses the most fuel in its production of power. The 5-year plan (1976-80) includes plans to lower the overall amount of energy used in industry by 5% annually and to lower use of electricity by 3%. Also, industrial production is planned to increase 6%.[42]

Nuclear energy is gaining in importance in the G.D.R. In 1977, there were three nuclear powerplants operating in the country, and two more are planned by 1980.

The total primary energy balance for 1976 and 1977 is shown in table 4.

Table 4.—German Democratic Republic: Total primary energy balance for 1976 and 1977

(Million tons of standard coal equivalent[1])

	Total primary energy	Coal (lignite, brown, bituminous)	Crude oil and petroleum products	Natural and associated gas	Hydroelectric power	Nuclear power
1976:						
Production[2]	94.3	74.6	0.1	18.8	0.2	0.6
Exports	5.0	1.4	3.5	--	.1	--
Imports	34.5	4.2	26.1	4.0	.2	--
Apparent consumption	123.8	88.4	22.7	22.8	.3	.6
1977:						
Production[2]	96.4	86.5	.1	19.0	.2	.6
Exports	6.9	2.0	4.1	--	.1	--
Imports	34.8	4.1	16.2	4.3	.2	--
Apparent consumption	125.0	78.6	22.2	23.3	.3	.6

[1]1 ton of standard coal equivalent (SCE)=7,000,000 kilocalories. Conversion factors used are: Hard coal, 1.0; lignite and brown coal, 0.3; crude oil, 1.47; natural gas, 1.33 (per thousand cubic meter); and hydroelectric and nuclear power, 0.125 (per thousand kilowatt-hours).

[2]Derived from table 1.

Source: World Energy Supplies, Statistical Papers, United Nations. New York. Ser. J, No. 18, 1975.

Coal.—The G.D.R. reportedly produced 28% of the world's lignite in 1977. 1978 production of raw lignite is projected at 254.4 million tons. The G.D.R. has 28,000 coal miners working in 35 open pits. Reportedly, 785 coal trains and almost 5,000 kilometers of track are used to transport this coal within the mines.[43] It was also reported that in 1977 the G.D.R. had 16 modern overburden conveyors, 240 heavy-duty excavators, and 60 spreaders.

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The G.D.R. is also a major manufacturer of coal mine machinery. About 50% of the total world production of brown coal is extracted with machinery produced by VEB Tagebauausrustungen, Krane und Forderanlagen, commonly known as TAKRAF.[44] Despite its large market share, the company is little known outside Eastern Europe.

Lignite in the G.D.R. is now being produced under geological and hydrological conditions of increasing complexity. For example, in 1977 it was necessary to remove about 4 to 5 cubic meters of overburden in order to mine a ton of raw lignite. Removal of the same amount of overburden in 1960 yielded 2.8 tons of lignite. The G.D.R.'s lignite is also diminishing in quality. It contains increasingly more sulfur and salts, which are especially problematic for powerplants. Also, coal is now mined from greater depths. The average mining depth for lignite has increased from 80 meters in 1970 to 100 meters in 1977, and is expected to reach 140 meters in 1985. During the 1976-80 period, new mines with an output of 78 million tons would have to be opened to replace the presently diminishing output from the G.D.R.'s strip mines. The lignite reserves of the G.D.R. are estimated at 15 to 20 billion tons, and are expected to supply the needs of the Nation's thermal electric plants to the year 2000 and beyond. Meanwhile, the development of nuclear power is expected to continue.

In 1977, the G.D.R. reclaimed about 2,500 hectares of surface-mined land. Since reclamation efforts began, 50,000 hectares have been restored for use as cropland, and another 10,000 hectares are expected to be reclaimed by 1980. About 0.4% of the G.D.R.'s croplands and forested areas are affected by surface mining.[45]

Hard coal in the G.D.R. was extracted from only a few mines in the Zwickau area, with an average annual output of slightly less than 100,000 tons. Hard coal mining in the G.D.R. has practically ceased because deposits are depleted. The last shipment of hard coal from the Martin Hoop mine in the Karl-Marx-Stadt area was made last November. Some 50% of this mine's work force is expected to remain at the mine for the next few years, infilling the main shaft and retrieving secondary materials.[46]

The major lignite-producing areas in 1977 were the Schlabendorf Süd (South) and Witznitz surface mines, which recently started operations. The new Schlabendorf Süd mine (in the Cottbus District) is administered by the Jugend lignite enterprise and is the main supplier of lignite to the Luebbenau, Vetschau, and other power stations. The mine's targeted 1978 production is 18 million tons. The Jugend enterprise was also developing surface mines in 1977 at the Cottbus Nord (North) District and was expanding the capacity of its Greifenhain surface mine. The enterprise reportedly earned M74 million from these mines in 1977. In 1978, the enterprise plans to remove an extra 1 million cubic meters of overburden and produce a total of 34.5 million tons of lignite.

The open pit lignite mine of the Regis combine in the Groitsch Dreieck (Groitsch Triangle) was opened ahead of schedule in 1977. When fully developed in 1981, annual production from this mine is anticipated to reach 6.5 million tons of raw coal. This mine is expected to become a significant supplier beyond the year 2000. Lignite reserves of the Groitsch Dreieck area are estimated at 200 million tons.[47]

In December of 1977, the Weisse Elster River (in the Leipzig District) was rerouted into a new 12-kilometer-long artificial channel just south of Leipzig. The lignite reserves in the exposed riverbed are estimated at 300 million tons. The M325 million rerouting project was completed in less than 5 years and is one of the major investments of the G.D.R.'s coal and energy ministry. The Leipzig-Zeitz railway line was also renovated and rebuilt as a two-track line to accommodate new production from the Weisse Elster. The new Zwenkau strip mine is also expected to be productive to the year 2000.[48]

Natural Gas.—Most of the G.D.R.'s natural gas production comes from the Magdeburg field near the country's border with the F.D.R. Plans are for the production of gas from the Salzwedel gasfield in the Magdeburg District to be upgraded in order to minimize the need for expensive imported gas. It was reported that 2.1 million cubic meters of gas per day was produced from that field, compared with 1 million cubic meters production in 1970. The present natural gas reserves of the G.D.R. are estimated at about 100 billion cubic meters.

In 1977, deep wells were drilled at a new gasfield in northern Mecklenburg Province. The well structure may extend offshore into the Baltic Sea, but because of tight censorship, little is known of this exploration and

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development program. Onshore, about 58% of the G.D.R.'s territory (63,000 square kilometers) is considered promising for potential discoveries of gas or oil.[49]

In order to meet domestic requirements, the G.D.R. imports gas from the Soviet Union. Such imports have increased repeatedly and in 1977 stood at over 3 billion cubic meters. Gas from the Soviet Union is transported through the Czechoslovakian gas-pipe system. Gas imports from the Soviet Union are expected to exceed 4 billion cubic meters in 1978, 6 billion cubic meters in 1979, and approach 7 billion cubic meters in 1980. The U.S.S.R. contracted to deliver 21.6 billion cubic meters of gas to the G.D.R. during the 1976-80 period. The Orenburg (Soyuz) gas pipeline is expected to nearly double the supply of Soviet gas to the G.D.R. when it is completed. Completion is scheduled for 1979. Under an agreement between the two countries, 2.8 billion cubic meters of natural gas per year will be piped to the G.D.R.

In 1977, the overall length of gas pipelines in the G.D.R. was 39,276 kilometers and underground gas-storage capacity was 170 million cubic meters. In the G.D.R.'s gas-pipe system, 715 kilometers of pipe are more than 50 years old and 67 kilometers are more than 100 years old. At the time these oldest pipes were laid down, gas was used primarily for cooking.[50]

The G.D.R. also manufactures coal gas at VEB Gaskombinat Schwarze Pumpe, a coal-gasification plant. The plant manufactures about 4 billion cubic meters of coal gas annually, or 25% of the G.D.R.'s total coal gas production.

Nuclear Power.—The G.D.R. produced about 5% of its electric energy, or 4.8 billion kilowatt-hours, from nuclear power. The country's development of nuclear energy has been slow, compared with its development in the West. Nonetheless, nuclear energy is gaining in importance in the G.D.R. By 1980, for example, the production of electric energy from nuclear power is expected to increase 26% as a result of the Nation's ongoing nuclear expansion.[51]

There were three operating nuclear plants in 1977. By 1978, a fourth unit is expected to be onstream. Nuclear plants that were operating in 1977 were the small 70-megawatt Rheinberg unit and two power station reactors with 440-megawatt capacities that are part of the Bruno Leuschner nuclear powerplant in Lubmin (in the Rostock District) near Greifswald on the Baltic coast. The fourth unit is expected to become operational in 1978, and three others are slated for operation by 1980.

Two 440-megawatt nuclear plants were under construction in 1977 in the Magdeburg District at Stendal. Construction and technical aid were again supplied by the Soviet Union. Completion of both units is scheduled for 1980.

The G.D.R.'s first nuclear plant was built near Rheinsberg in 1965. It is reported that the plant has an adverse effect on the ecology of Stechlin Lake because of its daily intake of 480,000 cubic meters of water. Furthermore, this water is also 10° warmer than normal when it is discharged back into the lake. It is planned that by 1980 the plant will discharge the heated outflow into nearby marshy wetland instead of into the lake.[52]

Petroleum.—The G.D.R.'s production of crude oil is estimated at approximately 7,000 barrels per day. Crude oil output comes from the Schwedt area and from a cluster of small fields near the Baltic Sea.

There are a total of 9 oil and oil-gas fields and 10 gas and gas-oil fields in the G.D.R. It was reported that Soviet orbiting satellites detected a number of potentially petroliferous structures along the G.D.R.'s Baltic coast and eastward into Polish territory. The presence of these structures was supposedly a decisive factor in a recent decision by Petrobalt (a cooperative enterprise including the G.D.R., Poland, and the U.S.S.R.) to order a Dutch jack-up rig for exploratory drilling in the Baltic.

There are four new oil fields close to the Baltic in the northern part of the Mecklenburg District, but no major oil discoveries have yet been reported. The largest of these fields is on Usedom Island, just west of the Polish border. The field extends into shallow water off the island's southern coast. The three other oil fields in the area are Rheinkenhagen, between the cities of Greifswald and Stralsund, and two fields just to the west and northwest, in the Greifswald-Stralsund-Grimmen Triangle. The Rheinkenhagen Field was discovered in 1961 and produces oil from Upper Permian beds from 2,300-foot depths. No data is available on the other three fields.

In 1977, the G.D.R. drilled a wildcat well at 8,000 meters, a new depth record for the country and for all of Europe. Romanian-built equipment was used to drill the well.

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The well's location is not known, but it is believed to be in the area of the triangle. The G.D.R. has a number of rigs capable of drilling below 6,000 meters. Besides the 8,000-meter well drilled in the Mecklenburg District, for example, a hole in the Grimmen District was drilled to more than 7,000 meters as early as 1974.[53]

The G.D.R. in 1977 imported almost 95% of its crude petroleum, or approximately 17.7 million tons, from the Soviet Union, compared with 16 million tons of crude petroleum imports in 1976. Due to price increases, the G.D.R. reportedly paid 41 transfer rubles per barrel for its imports of Soviet oil.[54]

The total capacity of the G.D.R.'s refineries is the third largest of any European country after the U.S.S.R. and Romania and is estimated at 440,000 barrels per day. The G.D.R. has sufficient refining capacity to meet its own demand of about 336,000 barrels per day and to export 50,500 barrels per day of gasoline, diesel fuel, and fuel oil.

Runs at the G.D.R.'s newly expanded refinery at Schwedt on the Oder River near the Polish border amounted to nearly 204,000 barrels per day in 1977. The plant is located at the terminal of the "Friendship" pipeline and processes Soviet crude delivered across Poland by the pipeline. The Leuna refinery was expanding its refining capacity for light petroleum products in 1977. The refinery produces about 20% of the country's chemicals, 78% of its diesel fuel, 86% of its heating oil, and 72% of its liquid gas. The value of the Leuna refinery's production reached M10 billion in 1977. The Leunawerke employs 30,000 workers and is the G.D.R.'s largest industrial complex. Crude petroleum is processed in Böhlen, Zeitz, and Lützkendorf.

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[1]Physical scientist, Branch of Foreign Data.
[2]GDR Foreign Trade (East Berlin). Aug. 31, 1977.
[3]Due to fluctuating exchange rates, a meaningful conversion from marks to U.S. dollars is impractical. The official exchange rate in 1977 is thought to have had a value of approximately US$1.00 = VM3.5 ("voluta marks").
[4]The Council for Mutual Economic Assistance (CMEA) is an organization of nine communist countries involved in economic cooperation and coordination, comprising in 1977 the following countries: Bulgaria, Cuba, Czechoslovakia, the G.D.R., Hungary, Mongolia, Poland, Romania, and the U.S.S.R.
[5]Neues Deutschland (East Berlin). Nov. 26-27, 1977, pp. 3-4.
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[6]Statistisches Jahrbuch der Deutsches Democratischen Republic 1978 (East Berlin). 1978.
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[7]Democratic Republic (Frankfurt am Main). Barclays, Aug. 23, 1978.
[8]Neue Bergbautechnik (Leipzig). V. 8, No. 10, October 1978, pp. 547-552.
[9]Gesetzblatt der Deutschen Democratischen Republik (East Berlin). P. I, No. 37, Dec. 28, 1977, pp. 414, 420.
[10]First work cited in footnote 5.
[11]Work cited in footnote 9.
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[14]Einheit (East Berlin). V. 33, No. 12, Nov. 10, 1978, pp. 1245-1251.
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[17]Die Wirtschaft (East Berlin). No. 17, Aug. 25, 1977, p. 7.
[18]Work cited in footnote 8.
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[20]First work cited in footnote 6.
[21]Work cited in footnote 7.
[22]Work cited in footnote 14.
[23]DIW-Wochenbericht (West Berlin). V. 45, No. 31, Aug. 3, 1978, pp. 299-304.
[24]Work cited in footnote 2.
[25]First work cited in footnote 5.
[26]Industrial Minerals (London). June 1978, p. 58.
[27]Work cited in footnote 19.
[28]Work cited in footnote 17.
[29]Work cited in footnote 17.
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[31]IWE-Wirtschaftsdienst (Bonn). V. 18, No. 40, Nov. 1977, p. 3.
[32]AW DDR-Aussenwirtschaft (East Berlin). No. 40, Oct. 5, 1977, p. 2.
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[37]World Bank (Washington, D.C.). World Potash Survey. Staff Working Paper No. 293, September 1978.
[38]Work cited in footnote 16.
[39]Work cited in footnote 37.
[40]Glückauf (Essen). V. 114, No. 20, Oct. 19, 1978, p. 881.
First work cited in footnote 6.
[41]First work cited in footnote 15.
[42]Die Wirtschaft (East Berlin). V. 38, No. 7, July 13, 1978, p. 27.
[43]Volksstimme (Magdeburg). June 20, 1978, p. 3.
[44]Mining Magazine (London). February 1978, pp. 119-127.
[45]Bauern Echo (East Berlin). Nos. 30-31, July 1977, p. 8.
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[48]Leipziger Volkszeitung (Leipzig). Dec. 28, 1977, p. 3.
[49]International Petroleum Encyclopedia (Tulsa). 1978, pp. 168-169.
[50]Work cited in footnote 43.
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[52]IWE-Wirtschaftsdienst (Bonn). V. 19, No. 27, July 18, 1978, p. 1.
[53]Work cited in footnote 49.
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[54]AW DDR-Aussenwirtschaft (East Berlin). No. 5, Feb. 1, 1978, pp. 1-2.
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The Mineral Industry of the Federal Republic of Germany

By Joseph B. Huvos[1]

The Federal Republic of Germany (FRG) is one of the world's major processors and consumers of minerals, most of which are imported. There is, however, a plentiful supply of domestic coal, potash, and salt. National efforts are focused on securing and expanding raw material supply by encouraging development of domestic resources at the State level, concluding trade agreements, and encouraging foreign exploration, development, and operations. For this purpose, private industry is assisted by Government guarantees, loans, and special tax rates.

In 1977, the performance of the country's economy was disappointing in most respects. Lower-than-expected consumer and Government expenditures, and a slackening of export growth underlay the weakening of demand during the year.

In 1977, the gross national product (GNP) of the FRG was $529 billion[2 3]. The unemployment rate remained at about 4.5%. The contribution of the minerals industry to the GNP was about 11%. Contribution of the individual sectors of the minerals industry to the GNP in 1976 and 1977 is shown in the following tabulation:

Sector	Contribution to gross national product[1]			Average 1977 employment (thousand persons)
	Million dollars		Change (percent)	
	1976	1977		
Mining:				
Coal	6,415	7,316	+14	215
Iron ore	47	6	-87	1
Potash and salt	535	597	+12	12
Other	1,597	1,862	+17	6
Total	8,594	9,781	+14	234
Processing:				
Iron and steel	18,727	17,770	-5	306
Nonferrous metals	6,099	7,193	+18	78
Stone and earths	9,080	9,731	+7	183
Petroleum refining	16,353	21,221	+30	29
Nuclear fuel	68	101	+49	2
Total	50,327	56,016	+11	598

[1]Does not include value-added tax and production outside the territory of the Federal Republic of Germany.

Source: Adapted from Statistisches Bundesamt, (Wiesbaden), Wirtschaft und Statistik, No. 4, 1978, pp. 227-228.

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In 1977, there were several major events in the FRG's mineral industry. Major plants commissioned included an all-hydraulic coal mine, a new nuclear powerplant, and a large-diameter-steel-pipe plant. There was a new gas discovery on the mainland, and natural gas started to flow from the Norwegian North Sea Ekofisk gasfields to the Federal Republic of Germany. A major iron ore mine and a barite mine closed. Large deficits in the steel industry brought about the beginning of a reorganization of the industry. The fuel oil tax was doubled, and funds were allocated for the purpose of saving energy. Bituminous coal was subsidized increasingly for electric powerplants and steel mills.

PRODUCTION

In 1977, production of most minerals declined with the exception of natural gas. Production of mineral commodities in 1976 and 1977 is shown in table 1.

Table 1.—Federal Republic of Germany: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Aluminum:			
Bauxite, gross weight	755	221	28
Alumina thousand tons	1,246	1,333	1,454
Metal:			
Primary do	678	697	742
Secondary:			
Unalloyed do	38	42	45
Alloyed do	250	305	347
Bismuth:			
Ore and concentrate[e]	11	11	11
Metal, smelter[e]	600	500	700
Cadmium, smelter	1,018	1,275	1,336
Cobalt, smelter	340	250	350
Copper:			
Mine output, metal content	1,961	1,613	1,210
Metal:			
Blister and anodes:			
Primary	168,125	193,695	178,267
Secondary	47,722	50,805	58,407
Refined including secondary:			
Electrolytic	318,916	334,150	340,725
Fire, refined	103,286	112,431	99,431
Gold:			
Mine output, metal content troy ounces	2,116	2,456	2,392
Metal including secondary do	351,471	346,874	319,803
Iron and steel:			
Iron ore and concentrate thousand tons	3,288	2,256	2,470
Pig iron and blast furnace ferroalloys do	30,074	31,849	28,959
Electric furnace ferroalloys do	257	239	210
Steel ingots and castings do	40,415	42,415	38,985
Semimanufactures do	28,873	29,793	28,758
Lead:			
Mine output, metal content	32,383	31,675	31,105
Metal, unalloyed:			
Primary	92,242	100,965	105,150
Secondary	167,924	177,340	204,467
Magnesium metal and alloys:			
Unwrought (secondary only)	800	500	600
Castings	167,924	177,340	204,467
Mercury (secondary only) 76-pound flasks	3,191	3,191	[e]3,200
Molybdenum metal	179	227	NA
Nickel including secondary[1]	122	130	91
Platinum troy ounces	3,601	2,283	[e]4,820
Silver:			
Mine output, metal content thousand troy ounces	1,079	1,026	1,061
Metal including secondary do	20,417	23,497	18,004
Tin metal including secondary	2,332	2,254	3,940
Tungsten metal	894	1,563	[e]1,400

See footnotes at end of table.

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Table 1.—Federal Republic of Germany: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
METALS —Continued				
Zinc:				
Mine output, metal content		116,072	115,344	114,152
Metal, unwrought, unalloyed, primary		294,725	304,754	341,582
NONMETALS				
Barite		[r]247,309	262,387	265,593
Bromine		4,270	4,154	3,736
Cement and clinker:				
Cement	thousand tons	[r]33,498	33,281	32,163
Clinker	do.	2,535	2,136	1,245
Clays:				
Fire clay (exclusive of klebsand)	do.	4,525	5,056	5,276
Kaolin (marketable)	do.	419	442	500
Bleaching	do.	599	628	642
Other (schieferton)	do.	90	108	129
Corundum, artificial		81,391	83,196	93,646
Diatomite and similar earth (marketable)		54,360	52,948	49,457
Feldspar (marketable)		395,833	419,976	393,793
Fertilizers:				
Crude:				
Phosphate rock	thousand tons	81	86	80
Potassic:				
Gross weight	do.	22,006	21,178	23,799
K_2O equivalent	do.	2,607	2,441	2,838
Manufactured:				
Nitrogenous (nitrogen content):				
Nitrogen fertilizers	do.	1,065	925	922
Mixed fertilizers	do.	387	322	381
Total	do.	1,452	1,247	1,303
Phosphatic (P_2O_5 content):				
Superphosphate	do.	43	40	43
Thomas slag fertilizers	do.	[r]202	167	134
Other phosphatic fertilizers	do.	[r]135	174	182
Mixed fertilizers	do.	378	317	364
Total	do.	758	698	723
Potassic K_2O equivalent:				
Marketable crude	do.	60	70	76
Chemically processed	do.	2,163	1,966	2,265
Total	do.	2,223	2,036	2,341
Content of mixed fertilizers[2]	do.	404	392	425
Mixed fertilizers, gross weight	do.	2,673	2,356	2,736
Fluorspar (marketable):				
Acid grade[e]		67,178	57,789	75,375
Metallurgical grade[e]		7,464	6,421	8,375
Total		74,642	64,420	83,750
Graphite:				
Crude		23,546	19,101	16,653
Marketable[3]		13,557	14,026	13,456
Gypsum and anhydrite, marketable	thousand tons	2,084	2,100	2,218
Lime, quicklime and hydrated lime, including dead-burned dolomite	do.	9,175	9,426	8,770
Pigments, natural mineral	do.	18	23	26
Pumice:				
Crude and washed	do.	3,584	3,689	3,137
Marketable	do.	1,915	2,197	1,749
Pyrite (marketable concentrate):				
Gross weight	do.	492	523	531
Sulfur content	do.	221	233	235
Quartz, quartzite, glass sand:				
Quartzite	do.	384	372	407
Quartz sand	do.	402	418	407
Quartz sand (unground) and glass sand	do.	5,669	6,111	6,737
Salt (marketable):				
Rock	do.	5,379	6,375	7,131
Marine and other	do.	3,937	4,942	5,192
Stone, sand and gravel, n.e.s:				
Dimension stone	thousand cubic meters	210	194	215
Limestone, industrial	thousand tons	52,574	52,615	48,953
Crushed and broken	do.	113,115	102,215	110,718
Slate[4]	do.	2	2	2
Basalt lava and lava sand	do.	6,894	5,922	6,623
Calcite	do.	7	4	9
Grinding stone	cubic meters	NA	48	63
Tuff	thousand tons	3	3	2

See footnotes at end of table.

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Table 1.—Federal Republic of Germany: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
NONMETALS —Continued			
Stone, sand and gravel, n.e.s —Continued			
Industrial sands:			
Molding sand thousand tons	1,007	1,123	1,183
Other (klebsand) do	140	--	--
Sand and gravel do	171,476	155,010	170,425
Sulfur, elemental byproduct do	521	608	845
Talc, including talc schist do	21	18	16
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	260,992	292,322	301,678
Coal:			
Anthracite thousand tons	7,651	6,628	6,067
Bituminous do	84,742	82,641	78,773
Lignite do	123,377	134,493	122,920
Total do	215,770	223,762	207,760
Coke:			
Metallurgical do	34,818	31,951	27,499
Gashouse do	1,250	971	809
Total do	36,068	32,922	28,308
Fuel briquets:			
Anthracite and bituminous do	1,697	1,357	1,305
Lignite do	4,984	4,390	4,104
Gas:			
Manufactured gas (excluding that from petroleum refineries):[5]			
Blast furnace gas million cubic feet	[r]201,293	201,399	174,312
Coke oven gas[6] do	288,414	263,517	223,294
Other gas do	[r]71,123	76,915	70,735
Total do	[r]560,830	541,831	468,341
Natural:			
Gross production do	645,445	665,537	678,565
Marketable production do	639,414	658,050	[e]670,000
Peat, agricultural use thousand tons	1,950	1,707	1,911
Petroleum:			
Crude thousand 42-gallon barrels	41,470	39,902	39,021
Refinery products:			
Gasoline, aviation and motor do	115,378	147,439	123,479
Jet fuel do	11,789	10,799	10,099
Kerosine do	257	378	456
Distillate fuel oil do	269,543	301,929	293,903
Residual fuel oil do	144,088	158,397	143,004
Lubricants do	8,444	9,081	6,763
Other:			
Liquefied petroleum gas do	26,498	32,680	38,741
Bitumen do	24,274	23,063	22,421
Unspecified do	90,132	98,534	86,999
Refinery fuel and losses do	35,762	38,230	46,253
Total do	726,165	820,530	772,118

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]Primary nickel and nickel contained in ferronickel, monel metal, and nickel oxide directly used by the steel industry.

[2]K_2O equivalent of potassic constiuent not added to K_2O equivalent of marketable crude and chemically processed potassic fertilizers because this would result in double counting.

[3]Produced in part from imported crude graphite.

[4]Exclusive of slate recovered from mine dumps.

[5]Natural gas equivalent, 240 kcal/ft3 (8400 kcal/m3).

[6]Includes water gas and generator gas from coke ovens.

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TRADE

In 1977, the members of the European Community continued as the FRG's principal trading partners, but member states of the Organization of Petroleum Exporting Countries (OPEC) were also important. In 1977, the FRG had a trade surplus with the OPEC countries for the first time amounting to $760 million.

The FRG's commodity trade in 1976 and 1977 is shown in tables 2 and 3. Mineral commodities exported from the FRG included petroleum products, iron, steel, nonferrous metals, and nonferrous metal products. Mineral imports consisted principally of petroleum and natural gas, iron ore, nonferrous metal ores, and various industrial minerals.

Major mineral imports from the United States in 1976 included nuclear fuels, coal, nonferrous metals, and industrial minerals. Mineral exports to the United States included iron and steel semimanufactures, coke, and nonferrous metals. U.S.-FRG trade in 1976 is shown in table 4.

Table 2.—Federal Republic of Germany: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations,1976
METALS			
Aluminum:			
Bauxite	10,178	4,615	Belgium-Luxembourg 2,204; France 779; Austria 635.
Alumina	227,639	324,235	Canada 99,978; Spain 92,036.
Aluminum hydroxide	111,172	132,026	Netherlands 28,028; Sweden 27,488; Poland 20,046.
Metal including alloys:			
Scrap	r31,500	49,388	Netherlands 17,208; Italy 14,204; France 9,844.
Unwrought	159,658	281,426	Italy 70,350; France 65,488; Belgium-Luxembourg 40,399.
Semimanufactures	195,538	279,081	France 67,887; Netherlands 40,118; Belgium-Luxembourg 35,869.
Antimony:			
Ore and concentrate	7	--	--
Metal including alloys, all forms	111	75	Mozambique 26; Austria 18; United States 10.
Arsenic:			
Natural sulfides	4	7	NA.
Trioxide, pentoxide, acids	609	200	Italy 94.
Beryllium metal including alloys, all forms kilograms	8	(1)	NA.
Bismuth metal including alloys, all forms	401	526	United States 111; United Kingdom 109.
Cadmium metal (including rhenium), including alloys, all forms	408	477	NA.
Chromium:			
Chromite	3,014	13,551	Netherlands 8,025; Austria 3,151; France 1,137.
Oxide and hydroxide	7,147	10,142	NA.
Metal including alloys, all forms	r105	274	United States 101; Belgium-Luxembourg 44; Romania 30.
Cobalt:			
Oxide and hydroxide	7,147	67	Belgium-Luxembourg 33; Netherlands 8.
Metal including alloys, all forms	222	322	Sweden 59; Netherlands 44; United States 38.
Columbium and tantalum metals including alloys, all forms:			
Columbium kilograms	15,858	21,628	NA.
Tantalum	29,331	61,401	NA.
Copper:			
Ore and concentrate	(1)	77	NA.
Matte	1,182	212	NA.
Copper sulfate	r674	833	NA.
Metal including alloys:			
Scrap	28,493	39,565	Italy 15,019; Belgium-Luxembourg 7,355; Austria 7,235.
Unwrought:			
Smelter	38,463	38,913	United Kingdom 23,206; Belgium-Luxembourg 15,095.

See footnotes at end of table.

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Table 2.—Federal Republic of Germany: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Copper —Continued			
Metal including alloys —Continued			
Unwrought —Continued			
Refined:			
Alloyed	6,597	9,101	Italy 4,814; Austria 1,210.
Unalloyed	49,790	53,700	Italy 10,898; France 8,843; Netherlands 6,678.
Master alloys	724	475	France 387.
Semimanufactures	r169,521	231,463	France 34,018; Netherlands 31,389; United States 25,186.
Gallium metal including alloys, all forms kilograms	r10,300	13,100	Switzerland 3,700; United States 3,100; Netherlands 2,300.
Germanium metal including alloys, all forms do	100	500	Romania 300; France 200.
Gold metal:			
Ash and waste do	198	4,435	All to Belgium-Luxembourg.
Scrap and sweepings troy ounces	35,803	418	NA.
Unwrought do	r489,302	583,214	Switzerland 160,561; Israel 104,490; Italy 98,863.
Semimanufactures do	180,055	152,489	Israel 26,687; Italy 17,748; United Kingdom 15,078.
Iron and steel:			
Ore and concentrate	4,551	3,836	Italy 814; Austria 541; Belgium-Luxembourg 436.
Roasted pyrite	139,198	106,754	Belgium-Luxembourg 70,511; Austria 23,231; Iran 8,510.
Metal:			
Scrap thousand tons	2,206	2,597	Italy 2,071; Belgium-Luxembourg 165.
Pig iron including cast iron do	763	821	France 340; Poland 117; Italy 116.
Sponge iron, powder and shot do	22	58	United Kingdom 29; Italy 6; Netherlands 6.
Spiegeleisen do	2	2	Italy 1.
Ferroalloys:			
Ferrochrome	30,826	65,495	Italy 23,851; Switzerland 14,534; France 10,657.
Ferromanganese	40,730	45,918	Belgium-Luxembourg 18,275; France 8,156; United Kingdom 4,933.
Ferronickel	53	35	Yugoslavia 29.
Ferrosilicon	15,936	16,612	France 3,907.
Ferrosilicochrome	1,300	5,124	Italy 4,379.
Ferrosilicomanganese	567	2,052	Belgium-Luxembourg 1,164; France 540.
Other	r11,305	16,422	Romania 2,549; Italy 1,869.
Steel, primary forms thousand tons	2,345	2,171	France 677; Italy 300; Belgium-Luxembourg 279.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	3,684	3,487	France 831; Netherlands 495.
Universals, plates, sheets do	5,268	4,845	U.S.S.R. 894; France 659.
Hoop and strip do	113	1,051	U.S.S.R. 165; Netherlands 143; France 140.
Rails and accessories do	278	204	Italy 50; Netherlands 30.
Wire do	286	276	France 59; Netherlands 48.
Tubes, pipes, fittings do	3,635	3,193	U.S.S.R. 746; People's Republic of China 385; Netherlands 370.
Castings and forgings, rough do	94	102	France 21; Belgium-Luxembourg 17; Netherlands 10.
Lead:			
Ore and concentrate	r3,434	7,094	Yugoslavia 3,876; Austria 2,101; Belgium-Luxembourg 1,117.
Oxides	8,880	12,759	Netherlands 6,069; Sweden 1,409.
Metal including alloys:			
Scrap	17,769	21,710	Italy 5,928; Netherlands 5,487; Belgium-Luxembourg 4,405.
Unwrought	80,902	72,198	Italy 36,004; France 1,2025.
Semimanufactures	8,662	9,184	Denmark 1,653; Switzerland 1,038.
Lithium:			
Ore and concentrate	186	505	Romania 221.
Oxides and hydroxides	517	544	France 157; Italy 129; Belgium-Luxembourg 75.
Metal, all forms	15	8	Switzerland 4; France 3.
Magnesium:			
Oxides, hydroxides, peroxides	3,063	4,453	Italy 1,304; U.S.S.R. 576; Austria 482.
Metal including alloys:			
Scrap	1,507	2,424	Italy 1,042; Netherlands 581; United Kingdom 253.
Unwrought	r233	194	Austria 68; France 54.
Semimanufactures	r336	299	Sweden 50; France 42; Netherlands 42.

See footnotes at end of table.

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Table 2.—Federal Republic of Germany: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations,1976
METALS —Continued			
Manganese:			
Ore and concentrate	r3,474	4,919	France 3,095; Netherlands 687.
Oxides	2,777	3,549	NA.
Metal	161	205	France 143.
Mercury 76-pound flasks	1,682	2,031	NA.
Molybdenum:			
Ore and concentrate	654	631	Belgium-Luxembourg 402; Sweden 139.
Metal including alloys, all forms	r206	263	NA.
Nickel metal including alloys:			
Scrap	3,013	5,682	Sweden 2,988; United Kingdom 741; Netherlands 701.
Unwrought	2,111	1,402	Netherlands 603; Switzerland 186; France 152.
Semimanufactures	13,676	15,189	United States 2,243; France 1,934; United Kingdom 1,617.
Platinum-group metals:			
Platinum:			
Ash and waste kilograms	--	29,929	France 9,601.
Scrap and sweepings troy ounces	376	1,174	Spain 1,013.
Metal including alloys, all forms do	r547,063	639,576	Italy 111,997; Netherlands 99,063.
Palladium metal including alloys, all forms do	246,221	204,781	Netherlands 67,903; Switzerland 54,123; United States 28,662.
Silicon metal	r1,052	600	Netherlands 237; France 145; United States 70.
Silver:			
Ash and waste kilograms	25,524	35,289	Belgium-Luxembourg 33,254.
Scrap and sweepings thousand troy ounces	37	18,734	Switzerland 16,216; Austria 2,502.
Metal including alloys do	31,616	35,387	Netherlands 5,234; France 4,342; Austria 2,502.
Tin:			
Ore and concentrate	--	1,014	All to United States.
Oxides	402	462	Brazil 69; France 57; United States 54.
Metal including alloys:			
Scrap	207	211	Netherlands 93; Denmark 49; United Kingdom 45.
Unwrought	1,716	2,203	Netherlands 774; France 456; United Kingdom 254.
Semimanufactures	823	805	Austria 63; Switzerland 46.
Titanium:			
Ore and concentrate	946	2,068	Austria 425; Netherlands 319; France 288.
Oxides	32,044	43,606	Italy 6,217; Netherlands 4,389; United States 4,292.
Metal including alloys, all forms	r1,579	1,411	France 329; Sweden 326; Italy 272.
Tungsten:			
Ore and concentrate	494	30	Belgium-Luxembourg 14; United Kingdom 13.
Metal including alloys, all forms	602	585	NA.
Uranium and thorium:			
Oxides, including rare earth oxides	803	689	United States 372; Japan 180.
Metals including alloys, all forms kilograms	r4,900	6,600	United States 1,400; Brazil 1,300; Belgium-Luxembourg 1,200.
Vanadium metal including alloys, all forms	30	(1)	NA.
Zinc:			
Ore and concentrate	r64,159	79,179	Belgium-Luxembourg 50,518; Netherlands 20,588.
Oxide	8,850	8,699	NA.
Metal including alloys:			
Scrap	6,934	5,245	Netherlands 2,815; Belgium-Luxembourg 1,020; Italy 658.
Blue powder	r5,110	5,615	Netherlands 1,445; Italy 1,353; Romania 951.
Unwrought	77,389	104,569	United States 45,587; Netherlands 13,724.
Semimanufactures	9,725	13,278	Netherlands 2,402; France 1,691.
Zirconium:			
Ore and concentrate	4,177	3,791	France 1,077; Italy 567; Netherlands 545.
Metal including alloys, all forms	104	85	United States 40; Japan 14.
Other:			
Ore and concentrate:			
Of columbium, tantalum, vanadium	776	921	United States 716; Japan 130.
Of base metals, n.e.s	21	(1)	NA.
Ash and residue containing nonferrous metals	147,935	182,541	Netherlands 73,235; Belgium-Luxembourg 37,047; Sweden 23,080.
Oxides, hydroxides, peroxides of metals,n.e.s	r14,706	14,321	Italy 1,348.

See footnotes at end of table.

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Table 2.—Federal Republic of Germany: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations,1976
METALS —Continued			
Other —Continued			
Metals including alloys, all forms:			
Metalloids:			
Arsenic and tellurium	7	12	Yugoslavia 7; United States 1.
Selenium and phosphorus[2]	10,380	12,182	NA.
Alkali, alkaline-earth, rare-earth metals	59	163	NA.
Pyrophoric alloys	90	61	NA.
Base metals including alloys, all forms, n.e.s	r571	592	France 230; Japan 156; Norway 86.
NONMETALS			
Abrasives:			
Natural:			
Pumice, emery, natural corundum, etc	633,595	388,454	Netherlands 291,734; Belgium-Luxembourg 77,073.
Dust and powder of precious and semiprecious stones kilograms	239	240	Brazil 146; Greece 69.
Grinding and polishing wheels and stones	r10,320	11,527	France 1,564; Netherlands 1,164.
Artificial:			
Corundum	30,807	35,769	Sweden 3,929; Netherlands 3,627; Italy 3,544.
Silicon carbide	16,894	21,038	NA.
Asbestos	77,770	67,953	Spain 8,346; France 7,954; Denmark 6,757.
Barite and witherite	46,992	65,582	Netherlands 32,721.
Boron materials:			
Crude natural borates	14,375	8,936	Italy 3,465; Sweden 2,954.
Oxide, acid, borates, perborates	26,754	38,485	Switzerland 19,574.
Bromine	269	203	Netherlands 152; Italy 46.
Cement thousand tons	2,071	2,078	Netherlands 1,446; Nigeria 164.
Chalk	13,589	15,693	Sweden 4,828; Netherlands 2,879; Denmark 2,430.
Clays and clay products (including all refractory brick):			
Crude:			
Andalusite and kyanite	5,482	2,695	Italy 661; Austria 443; Sweden 380.
Bentonite	32,856	48,335	France 15,173; Netherlands 10,431; Belgium-Luxembourg 10,183.
Ceramic clay	412,004	584,395	Netherlands 147,817; Italy 137,399; Belgium-Luxembourg 133,028.
Chamotte	31,152	36,972	Netherlands 15,183; Italy 7,522; Switzerland 5,397.
Dinas	14,299	15,882	France 3,837; Italy 3,406; Netherlands 2,650.
Fire clay	205,907	231,228	Italy 94,168; Netherlands 44,121; Belgium-Luxembourg 28,713.
Fuller's earth	402	226	NA.
Kaolin	108,378	97,734	Austria 31,296; Italy 20,086; Netherlands 14,297.
Other	280,835	278,213	Netherlands 219,789.
Products:			
Refractory (including nonclay brick)	683,554	636,392	France 125,714; Netherlands 43,461; Italy 43,382.
Nonrefractory	648,974	772,806	France 212,734; Belgium-Luxembourg 172,066; Netherlands 138,645.
Cryolite and chiolite kilograms	300	12,900	NA.
Diamond:			
Crude:			
Not set or strung thousand carats	r4	25	NA.
Other do	r125	134	Belgium-Luxembourg 46; Netherlands 36; Switzerland 15.
Industrial do	r123	191	Ireland 81; Netherlands 38; Switzerland 21.
Diatomite and other infusorial earth	r4,883	4,805	Netherlands 2,263; United Kingdom 867.
Feldspar, leucite, nepheline, nepheline syenite	10,849	14,744	France 4,062; Italy 2,144; Belgium-Luxembourg 1,609.
Fertilizer materials:			
Crude:			
Phosphatic	7,797	1,880	Madagascar 800; Switzerland 587; Netherlands 335.
Potassic	42,986	40,492	Belgium-Luxembourg 26,017; United Kingdom 8,830; Netherlands 5,441.
Manufactured:			
Nitrogenous thousand tons	950	1,091	Belgium-Luxembourg 379; Brazil 186.
Phosphatic do	83	36	Hungary 8; Ireland 8; Belgium-Luxembourg 7.
Potassic do	1,794	1,573	Belgium-Luxembourg 206; India 146; Denmark 136.
Other, including mixed do	678	489	France 119; Denmark 58; Belgium-Luxembourg 45.
Ammonia, anhydrous do	278	209	Denmark 110; Belgium-Luxembourg 44; United Kingdom 24.

See footnotes at end of table.

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Table 2.—Federal Republic of Germany: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations,1976
NONMETALS —Continued			
Fluorspar	r20,925	14,478	Austria 4,052; Belgium-Luxembourg 3,427; France 2,707.
Graphite, natural	6,107	7,284	Italy 2,154; United States 1,177.
Gypsum and plasters	286,121	272,025	Netherlands 166,485; Switzerland 33,173.
Iodine	28	36	Belgium-Luxembourg 14.
Lime	420,728	611,796	Netherlands 460,835; Belgium-Luxembourg 67,102; France 65,715.
Mica:			
Crude, including splittings and waste	r767	924	Switzerland 443; Austria 132.
Worked, including agglomerated splittings	204	269	United Kingdom 74; Denmark 28; Austria 25.
Pigments, mineral:			
Natural, crude	r3,236	3,008	Netherlands 770; United States 583.
Iron oxides, processed	r89,386	128,230	France 17,408; United States 17,231; United Kingdom 14,128.
Precious and semiprecious stones, except diamond:			
Natural kilograms	r320,024	249,055	Hong Kong 65,163; Japan 35,148; People's Republic of China 16,305.
Manufactured do	7,121	15,584	United States 8,176; Italy 2,254; Japan 1,958.
Pyrite (gross weight)	500	3,863	NA.
Salt thousand tons	1,589	1,821	Belgium-Luxembourg 1,259; Sweden 314.
Sodium and potassium compounds, n.e.s:			
Caustic soda do	946	1,007	Netherlands 149; Australia 88.
Caustic potash, sodic and potassic peroxides do	12	17	U.S.S.R. 8; United Kingdom 1.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	r2,867	2,504	Austria 1,517.
Slate	13,338	14,522	Netherlands 7,311; Belgium-Luxembourg 4,739; Denmark 1,482.
Other	459,035	508,575	Netherlands 359,339; Switzerland 125,645.
Worked:			
Slate	649	823	Netherlands 358; Belgium-Luxembourg 4,739; Denmark 1,482.
Paving and flagstone	9,052	12,923	Denmark 5,337; Belgium-Luxembourg 3,104; Netherlands 2,241.
Other	15,350	18,094	France 4,330; Belgium-Luxembourg 4,241; Netherlands 3,345.
Dolomite, chiefly refractory grade	r170,665	238,096	France 85,006; Netherlands 77,798; Belgium-Luxembourg 64,599.
Gravel and crushed rock thousand tons	r11,808	10,849	Netherlands 8,732; Belgium-Luxembourg 860.
Limestone (except dimension)	45,522	52,825	Netherlands 32,583; Belgium-Luxembourg 15,951.
Quartz and quartzite	59,937	85,186	Belgium-Luxembourg 33,348; Austria 15,838; Netherlands 9,940.
Sand, excluding metal bearing thousand tons	r7,366	6,728	Netherlands 5,691; Belgium-Luxembourg 580.
Sulfates, natural, magnesium sulfate (Kieserite)	445,473	439,194	Norway 68,646; France 61,602; Netherlands 53,601.
Sulfur:			
Elemental:			
Other than colloidal	199,018	144,197	Denmark 59,699; Switzerland 28,398.
Colloidal	2,516	2,420	United Kingdom 413; India 288.
Sulfur dioxide	15,019	13,272	Belgium-Luxembourg 6,227; Sweden 2,057; Austria 1,725.
Sulfuric acid, including oleum	r737,922	640,086	Netherlands 122,806; France 69,901.
Talc, steatite, soapstone, pyrophyllite	r5,748	7,057	Denmark 3,533; Belgium-Luxemburg 708.
Other:			
Crude:			
Meerschaum, amber, jet kilograms	r300	100	NA.
Pottery, broken	r22,401	26,324	Netherlands 15,138; France 4,856; Austria 3,743.
Pozzolan and Santorin earth	9,188	5,397	Switzerland 1,823; France 1,007.
Vermiculite, perlite, chlorite	473	693	NA.
Other thousand tons	r1,372	1,421	Netherlands 1,172.
Slag, dross, and similar waste, not metal bearing:			
From iron and steel manufacture do	2,328	2,589	Netherlands 2,511.
Slag and ash, n.e.s do	1,056	696	Netherlands 537; France 112.
Oxides and hydroxides of strontium and barium	r2,440	3,029	France 935; United States 723; Belgium-Luxembourg 459.

See footnotes at end of table.

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Table 2.—Federal Republic of Germany: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations,1976
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	2,667	2,416	Switzerland 454.
Carbon black and gas carbon:			
Carbon black	90,410	r88,844	France 18,097; Belgium-Luxembourg 11,927; Austria 11,080.
Gas carbon	209	139	NA.
Coal and briquets:			
Anthracite and bituminous coal thousand tons	14,468	12,805	France 4,529; Belgium-Luxembourg 3,784; Italy 2,378.
Briquets of anthracite and bituminous coal do	240	215	Belgium-Luxembourg 97; France 40; Austria 35.
Lignite and lignite briquets do	486	461	France 175; Austria 138; Belgium-Luxembourg 59.
Coke and semicoke do	r7,365	7,099	France 2,251; Belgium-Luxembourg 2,208; United States 852.
Hydrogen and other rare gases	19,500	22,061	Mainly to France and Italy.
Peat, including peat briquets and litter	398,901	422,701	Netherlands 261,928; Switzerland 55,248; France 46,757.
Petroleum:			
Crude thousand 42-gallon barrels	103	224	Mainly to Netherlands.
Refinery products:			
Gasoline, motor do	r5,725	3,457	Austria 1,888; Switzerland 55,248; France 46,757.
Kerosine and white spirit do	r9,614	10,013	Switzerland 634; Denmark 600.
Distillate fuel oil do	8,691	8,624	Switzerland 4,697; France 821.
Residual fuel oil do	r18,655	19,068	Austria 2,962; France 1,679 Belgium-Luxembourg 1,456.
Lubricants do	r2,675	3,031	Belgium-Luxembourg 629; United Kingdom 356; Sweden 334.
Mineral jelly and wax do	r931	1,105	Netherlands 108; Italy 102; Denmark 81.
Liquefied petroleum gas do	3,189	3,676	Belgium-Luxembourg 675; Netherlands 605; Italy 363.
Other do	13,580	15,456	France 4,686; Netherlands 3,647; Austria 1,194.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals thousand tons	187	153	Netherlands 50; Belgium-Luxembourg 23.

rRevised. NA Not available.
[1]Less than 1/2 unit.
[2]Includes elemental sodium and potassium.

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Table 3.—Federal Republic of Germany: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principle sources, 1976
METALS			
Aluminum:			
Bauxite ____ thousand tons	r4,213	4,087	Australia 2,239; Guinea 1,174.
Alumina	471,753	473,148	Australia 233,820; Italy 186,270.
Aluminum hydroxide	2,541	2,652	United States 1,733; France 760.
Metal including alloys:			
Scrap	r92,626	102,532	Netherlands 31,060; Austria 13,357; France 10,564.
Unwrought	r284,453	405,149	Norway 175,433; Netherlands 61,922; United Kingdom 36,152.
Semimanufactures	140,305	205,487	France 50,509; Belgium-Luxembourg 48,286; Netherlands 33,814.
Antimony:			
Ore and concentrate	2,129	3,514	Turkey 900; Republic of South Africa 894; Thailand 463.
Metal including alloys, all forms	841	1,064	Belgium-Luxembourg 601; People's Republic of China 169.
Arsenic hydroxide	957	690	Belgium-Luxembourg 214; Sweden 135; People's Republic of China 13.
Beryllium metal including alloys, all forms kilograms	496	552	United States 452.
Bismuth metal including alloys, all forms	259	246	United Kingdom 23.
Cadmium metal including alloys, all forms	631	1,140	Belgium-Luxembourg 310; Japan 283; North Korea 181.
Calcium metal including alloys, all forms kilograms	4,700	7,000	Peru 1,400; Belgium-Luxembourg 1,000; Netherlands 1,000.
Chromium:			
Chromite	561,035	547,293	Republic of South Africa 177,864; U.S.S.R. 152,449; Turkey 64,895.
Oxide and hydroxide	2,273	1,568	U.S.S.R. 1,018; Netherlands 238.
Metal including alloys, all forms	391	435	Japan 181; France 126; Belgium-Luxembourg 54.
Cobalt:			
Oxide and hydroxide	153	346	Belgium-Luxembourg 197; France 66; United Kingdom 41.
Metal including alloys, all forms	r1,482	1,870	Zaire 856; Belgium-Luxembourg 388.
Columbium and tantalum metals, including alloys, all forms:			
Columbium ____ kilograms	4,769	3,161	United States 2,811.
Tantalum ____ do	138,994	124,852	United States 107,546.
Copper:			
Ore and concentrate	564,352	615,285	Papua New Guinea 284,838; Norway 106,363; Indonesia 70,518.
Matte	2,051	1,027	Australia 518; United Kingdom 445.
Copper sulfate	6,349	9,752	France 5,932; U.S.S.R. 1,691.
Metal including alloys:			
Scrap	89,294	114,699	France 34,122; Netherlands 17,472; United Kingdom 14,563.
Unwrought:			
Smelter	119,850	130,790	Republic of South Africa 62,048; Chile 52, 156.
Refined	393,936	401,303	Chile 90,914; Zambia 81,150; Belgium-Luxembourg 55,901.
Alloys	39,086	47,345	United Kingdom 11,448; Poland 6,861.
Master alloys	1,235	2,221	United Kingdom 1,827; Belgium-Luxembourg 223.
Semimanufactures	115,190	144,137	Belgium-Luxembourg 51,901; France 40,803; Italy 15,901.
Gallium metal including alloys, all forms kilograms	4,700	7,000	Belgium-Luxembourg 1,000; Netherlands 1,000; Peru 1,000.
Gold metal:			
Ash and waste ____ do	96,946	47,646	United States 19,340; Switzerland 17,135.
Scrap and sweepings thousand troy ounces	1,154	831	Belgium-Luxembourg 226; Netherlands 152; Switzerland 149.
Metal:			
Unwrought ____ do	r2,127	2,922	Switzerland 1,639; Republic of South Africa 428.
Semimanufactures ____ do	r27	29	United States 13; Republic of South Africa 6; Switzerland 6.
Hafnium metal including alloys, all forms kilograms	2	--	
Iron and steel:			
Ore and concentrate ____ thousand tons	44,322	46,775	Brazil 12,075; Liberia 6,600; Canada 6,355.
Roasted pyrite ____ do	843	906	Spain 584; Belgium-Luxembourg 174; Portugal 112.
Metal:			
Scrap ____ do	1,720	1,545	Netherlands 746; Belgium-Luxembourg 206; France 202.
Pig iron including cast iron ____ do	158	292	Brazil 85; U.S.S.R. 73; Canada 47.

See footnotes at end of table.

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Table 3.—Federal Republic of Germany: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principle sources, 1976
METALS —Continued			
Iron and steel —Continued			
Metal —Continued			
Sponge iron, powder, shot thousand tons	38	39	France 19; Sweden 14; United Kingdom 6.
Spiegeleisen	503	301	NA.
Ferroalloys:			
Ferrochrome thousand tons	88	139	Republic of South Africa 91.
Ferromanganese do	157	174	Norway 78; France 48.
Ferronickel do	38	56	Greece 19; New Caledonia 19; Japan 9.
Ferrosilicon do	116	136	Norway 52; France 41.
Ferrisilicochrome do	13	20	Republic of South Africa 15.
Ferrisilicomanganese do	70	71	Norway 42; Republic of South Africa 13; Czechoslovakia 7.
Other do	r13	18	France 5; Belgium-Luxembourg 3; Brazil 2.
Steel, primary forms do	1,859	1,943	Belgium-Luxembourg 470; Netherlands 418; Austria 215.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	2,690	3,857	Belgium-Luxembourg 1,347; Italy 640; France 468.
Universals, plates, sheets do	3,185	3,806	Belgium-Luxembourg 1,189; France 663; Austria 282.
Hoop and strip do	456	550	Belgium-Luxembourg 239; France 132; Netherlands 77.
Rails and accessories do	20	19	Netherlands 9; Sierra Leone 3; Sweden 3.
Wire do	r152	610	Belgium-Luxembourg 91; France 46.
Tubes, pipes, fittings do	538	685	Italy 142; Netherlands 120; France 97.
Castings and forgings, rough do	25	29	Romania 6; France 5; Netherlands 5.
Lead:			
Ore and concentrate	208,978	190,104	Sweden 54,109; Canada 28,356; United States 18,844.
Oxides	3,765	6,109	Belgium-Luxembourg 2,261; France 1,930.
Metal including alloys:			
Scrap	10,205	23,769	Netherlands 9,432; France 5,598; Belgium-Luxembourg 2,041.
Unwrought	122,829	110,453	Sweden 24,308; United Kingdom 20,973; North Korea 18,714.
Semimanufactures	1,885	2,465	Belgium-Luxembourg 1,155; France 502; Yugoslavia 424.
Lithium:			
Ore and concentrate	3,521	4,308	Republic of South Africa 3,747.
Oxides and hydroxides	r459	344	United States 177; U.S.S.R. 100.
Metal, all forms	26	17	United States 13.
Magnesium:			
Oxides, hydroxides, peroxides	3,409	5,450	France 1,337; Netherlands 1,124.
Metal including alloys:			
Scrap	r3,846	1,893	Netherlands 723; Austria 316.
Unwrought	r19,530	28,324	Norway 13,564; Italy 4,198; United States 3,761.
Semimanufactures	r567	425	United States 295.
Manganese:			
Ore and concentrate thousand tons	733	610	Republic of South Africa 358; Australia 144.
Oxides	1,449	2,169	Belgium-Luxembourg 1,508; Japan 287; Greece 241.
Metal	4,365	6,208	Republic of South Africa 2,726; France 1,180; Netherlands 1,088.
Mercury 76-pound flasks	r12,154	19,929	Italy 11,313; Algeria 5,831.
Molybdenum:			
Ore and concentrate	14,736	41,674	Australia 15,895; United States 11,920; Netherlands 4,357.
Metal including alloys, all forms	376	505	Austria 271; United States 107.
Nickel:			
Ore and concentrate	NA	2	NA.
Matte and speiss	6,550	13,820	Australia 8,419; Canada 4,208.
Metal including alloys:			
Scrap	6,453	7,408	France 1,448; United States 1,390.
Unwrought	36,387	43,080	United Kingdom 8,307; United States 8,188; Norway 7,941.
Semimanufactures	4,416	4,813	Australia 1,419; United Kingdom 905; France 790.
Platinum-group metals:			
Platinum:			
Ash and waste kilograms	275,580	199,801	Switzerland 111,218.
Scrap and sweepings thousand troy ounces	126	144	Belgium-Luxembourg 74; Netherlands 18; United States 14.
Metal including alloys, all forms do	286	315	UnitedKingdom 133; United States 57; U.S.S.R. 32.

See footnotes at end of table.

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Table 3.—Federal Republic of Germany: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principle sources, 1976
METALS —Continued			
Platinum-group metals —Continued			
Palladium metal including alloys, all forms thousand troy ounce	368	631	United States 228; U.S.S.R. 198; United Kingdom 136.
Other metals including alloys, all forms do	77	58	Republic of South Africa 25; United Kingdom 21.
Silicon metal including alloys, all forms	294,120	45,243	Norway 14,792; France 11,963; Republic of South Africa 6,106.
Silver:			
Ash and waste kilograms	265,186	491,323	United States 270,703.
Scrap and sweepings thousand troy ounces	3,374	3,556	United States 644; United Kingdom 607; Belgium-Luxembourg 501.
Metal including alloys, all forms do	31,672	42,535	Belgium-Luxembourg 6,057; United Kingdom 5,482; United States 5,004.
Tin:			
Ore and concentrate	9,883	9,550	Bolivia 7,470; Peru 1,398.
Oxides	54	48	Japan 21; France 9; Italy 7.
Metal including alloys:			
Scrap	449	394	Netherlands 145; Poland 103.
Unwrought	13,957	16,290	Indonesia 4,576; Thailand 3,781; Malaysia 2,744.
Semimanufactures	609	1,198	Netherlands 1,079.
Titanium:			
Ore and concentrate	330,191	472,733	Norway 338,536; Canada 66,402; Australia 47,397.
Oxides	19,533	24,396	Belgium-Luxembourg 12,281; Netherlands 4,660; Italy 3,376.
Metal including alloys, all forms	3,483	3,298	U.S.S.R. 2,121; Japan 407.
Tungsten:			
Ore and concentrate	3,365	4,362	People's Republic of China 1,298; France 1,219.
Oxide and hydroxide	174	33	France 26; United Kingdom 5.
Metal including alloys, all forms	91	83	United States 37; Belgium-Luxembourg 10; Netherlands 9.
Uranium and thorium:			
Ore and concentrate	7	NA	
Compounds	3	22	All from France.
Uranium metal including alloys, all forms kilograms	42,900	78,100	United States 40,500.
Vanadium:			
Oxides, hydroxides, pentoxides	408	433	Finland 232; Republic of South Africa 88; United States 51.
Metal including alloys, all forms	5	7	Belgium-Luxembourg 4.
Zinc:			
Ore and concentrate	550,888	601,349	Canada 217,826; Republic of South Africa 94,131; Sweden 61,101.
Oxide and peroxide	4,374	5,546	France 2,196; Netherlands 1,074.
Metal including alloys:			
Scrap	5,414	6,339	United Kingdom 1,542; Denmark 1,326; Netherlands 1,066.
Blue powder	8,838	13,014	Belgium-Luxembourg 10,925.
Unwrought	90,535	133,778	Belgium-Luxembourg 73,128; Netherlands 15,239.
Semimanufactures	17,738	19,638	France 8,828; Netherlands 3,604; Yugoslavia 3,057.
Zirconium metal including alloys, all forms	332	348	United States 36.
Other:			
Ore and concentrate:			
Of columbium, tantalum, vanadium	2,097	1,651	Brazil 1,483.
Of base metals, n.e.s	4,143	3,957	Australia 3,752.
Ash and residue containing nonferrous metals	277,449	381,594	Canada 125,052; Italy 32,070; United Kingdom 23,886.
Oxides, hydroxides, peroxides of metals, n.e.s	3,873	5,068	Belgium-Luxembourg 1,817; United Kingdom 821.
Metals including alloys, all forms:			
Metalloids:			
Arsenic and tellurium	32	61	Belgium-Luxembourg 15; U.S.S.R. 12; Sweden 10.
Selenium and phosphorus	18,349	23,738	NA.
Alkali, alkaline-earth, rare-earth metals	269	495	France 349.
Pyrophoric alloys, all forms	r836	30	NA.
NONMETALS			
Abrasives:			
Natural:			
Pumice, emery, natural corundum, etc	34,939	21,505	Greece 11,462; Italy 5,289; United States 2,421.
Dust and powder of precious and semiprecious stones kilograms	1,242	1,496	United States 824; Ireland 483.
Grinding and polishing wheels and stones	4,655	5,896	Austria 1,266; Spain 921; Italy 795.
Artificial:			
Corundum	22,634	28,510	Netherlands 9,747;Austria 4,789; Hungary 4,540.
Silicon carbide	49,557	61,450	Norway 12,670.

See footnotes at end of table.

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Table 3.—Federal Republic of Germany: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principle sources, 1976
NONMETALS —Continued			
Asbestos	386,188	382,570	Canada 289,096; U.S.S.R. 41,296.
Barite and witherite	91,156	124,162	NA.
Boron materials:			
Crude natural borates	116,951	114,347	United States 72,823; Turkey 38,759.
Oxide and acid	11,623	13,854	France 5,900; Turkey 2,687; United States 2,589.
Bromine	1,805	3,110	Israel 2,601.
Cement thousand tons	540	627	France 274; Belgium-Luxembourg 144; Netherlands 95.
Chalk do	69	76	France 69.
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite thousand tons	44	93	United States 67; Greece 11.
Ceramic clays:			
Kaolin do	555	653	United Kingdom 388; United States 95; Czechoslovakia 92.
Other do	109	140	Czechoslovakia 51; Netherlands 34; France 31.
Fire clays:			
Raw do	85	62	Czechoslovakia 17; Republic of South Africa 15; France 12.
Burned, including chamotte do	182	172	Czechoslovakia 71; United States 48; France 22.
Fuller's earth do	9	9	United States 4; Spain 4.
Kyanite, sillimanite, andalusite, mullite do	24	33	United States 17; France 5; Republic of South Africa 3.
Other do	41	61	Netherlands 30; France 17.
Products:			
Refractory (including nonclay brick) do	245	235	Austria 77; Czechoslovakia 31; France 27.
Nonrefractory do	1,048	1,278	Netherlands 505; Italy 367; France 148.
Cryolite and chiolite	1,955	4,578	Denmark 3,418; Greenland 1,142.
Diamond:			
Gem:			
Crude or rough cut thousand carats	70	80	NA.
Other do	11,810	7,935	Brazil 3,210; Republic of South Africa 1,330; Madagascar 935.
Industrial do	860	770	Republic of South Africa 305; Belgium-Luxembourg 220; Netherlands 110.
Diatomite and other infusorial earth	87,261	70,896	Denmark 38,807; Belgium-Luxembourg 16,244.
Feldspar, leucite, nepheline, nepheline syenite	102,585	101,785	Norway 77,811; Italy 10,181.
Fertilizer materials:			
Crude:			
Nitrogenous	NA	1,043	NA.
Phosphatic thousand tons	2,292	2,370	United States 1,135; Morocco 588; U.S.S.R. 495.
Manufactured:			
Nitrogenous	866,567	1,167,000	Belgium-Luxembourg 541,326; Netherlands 247,359; Romania 98,121.
Phosphatic	735,623	980,913	Belgium-Luxembourg 737,174; Tunisia 84,178.
Potassic	61,211	76,559	France 71,264.
Mixed	340,766	446,987	Belgium-Luxembourg 142,087; France 123,764; United Kingdom 72,814.
Fluorspar	261,094	244,643	Spain 31,310; Italy 30,913.
Graphite, natural	26,043	29,665	Austria 6,231; People's Republic of China 4,006; Norway 3,883.
Gypsum and plaster	303,321	411,394	France 177,815; Austria 137,824.
Iodine	864	814	Japan 657; Chile 127.
Magnesite	403,344	260,684	Greece 101,500; North Korea 33,233; Italy 31,416.
Mica:			
Crude, including splittings and waste	8,008	8,058	India 1,738; Republic of South Africa 1,378; Argentina 1,228.
Worked, including agglomerated splittings	599	615	France 309; Belgium-Luxembourg 227.
Pigments, mineral:			
Natural, crude	1,876	2,155	Austria 1,778; France 292.
Iron oxides and hydroxides	2,849	3,414	Netherlands 1,541; United States 340.
Precious and semiprecious stones, except diamond:			
Natural kilograms	9,530	8,318	India 2,321; Taiwan 1,084.
Manufactured do	22,551	27,323	Switzerland 16,911.
Pyrite (gross weight) thousand tons	498	175	U.S.S.R. 70; Spain 67; Norway 21.
Salt	641,976	776,954	Netherlands 641,775; France 98,535.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	128,323	520,237	Belgium-Luxembourg 363,833; Netherlands 79,820.
Caustic potash, sodic and potassic peroxides	NA	10,888	Czechoslovakia 1,976; Sweden 1,789.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	192,518	159,671	Austria 57,818; Italy 41,222.

See footnotes at end of table.

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Table 3.—Federal Republic of Germany: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principle sources, 1976
NONMETALS —Continued			
Stone, sand and gravel —Continued			
Dimension stone —Continued			
Crude and partly worked —Continued			
Slate	13,290	17,572	United Kingdom 6,289; Portugal 3,637; Spain 1,941.
Other	343,496	298,182	Denmark 52,511; Sweden 49,525; Austria 45,244.
Worked:			
Building and monumental stone	407,946	447,192	Italy 397,935.
Paving, flagstone, related materials	135,510	117,611	Portugal 60,613; Italy 15,555; Poland 12,087.
Slate	9,181	11,278	Spain 5,202; Italy 1,959; France 1,378.
Dolomite, including burned	684,877	662,417	Belgium-Luxembourg 593,578.
Gravel and crushed rock thousand tons	16,084	13,815	France 8,096; Denmark 2,204.
Limestone do	1,446	1,621	Austria 963; Sweden 248; Belgium-Luxembourg 229.
Quartz and quartzite:			
Quartz, crystal kilograms	479	116	Japan 81.
Other	127,381	98,412	Belgium-Luxembourg 32,362; Sweden 22,233; Yugoslavia 11,620.
Sand, excluding metal bearing thousand tons	3,086	2,609	France 1,978; Netherlands 363.
Sulfates, natural: Magnesium sulfate (Kieserite)	NA	10	NA.
Sulfur:			
Elemental:			
Other than colloidial	303,908	480,574	Poland 250,574; Canada 105,253; United States 63,370.
Colloidial	519	461	France 389.
Sulfur dioxide	1,275	1,322	Poland 894; Switzerland 408.
Sulfuric acid	43,918	68,551	France 16,841; Netherlands 11,553; Switzerland 8,449.
Talc, steatite, soapstone	87,517	111,223	Austria 42,106; Italy 17,332; France 16,170.
Vermiculite, chlorite, perlite	94,103	100,071	Greece 72,314; Hungary 13,154; Republic of South Africa 12,262.
Other:			
Crude:			
Meerschaum, amber, jet	9,267	17,372	Spain 17,342.
Pottery, broken	68,982	64,529	Netherlands 23,278; France 12,611; U.S.S.R. 6,644.
Other	445,154	566,478	France 235,505; United Kingdom 119,144; Austria 62,049.
Slag, dross and similar waste, not metal bearing:			
From iron and steel manufacture thousand tons	1,527	1,455	Belgium-Luxembourg 736; France 567.
Slag and ash, n.e.s do	183	199	France 113; Belgium-Luxembourg 53.
Oxide and hydroxide of strontium and barium	120	647	France 392; Netherlands 115.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	19,253	21,605	Trinidad and Tobago 12,983; United States 7,324.
Carbon black	30,001	45,894	Netherlands 16,770; France 15,644.
Coal and briquets:			
Anthracite and bituminous coal thousand tons	6,244	5,970	Poland 2,137; United States 1,094; South African Customs Union 672.
Briquets of anthracite and bituminous coal do	4	NA	
Lignite and lignite briquets do	1,647	1,565	Czechoslovakia 1,556.
Coke and semicoke do	1,283	1,266	United States 250; France 196; United Kingdom 128.
Gas, natural do	23,702	26,693	NA.
Peat and briquets do	24	45	U.S.S.R. 32; Netherlands 6; Poland 6.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	618,898	723,865	Libya 160,814; Saudi Arabia 137,756; Iran 132,793.
Refinery products:			
Gasoline, motor spirit do	34,060	29,036	Netherlands 11,552; Belgium-Luxembourg 3,596; Romania 3,456.
Kerosine, white spirit do	10,292	13,322	Netherlands 8,207; Belgium-Luxembourg 2,221.
Distillate fuel oil do	143,918	162,770	Netherlands 76,316; U.S.S.R. 29,855; France 11,324.
Residual fuel oil do	31,042	34,998	Netherlands 19,827; France 4,405; Belgium-Luxembourg 2,779.

See footnotes at end of table.

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Table 3.—Federal Republic of Germany: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principle sources, 1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum —Continued			
Refinery products —Continued			
Lubricants thousand 42-gallon barrels	1,148	1,702	United Kingdom 464; France 316; Italy 260.
Other:			
Mineral jelly and wax do	952	1,078	Netherlands 202; France 112.
Unspecified do	47,341	53,242	Netherlands 21,616; United States 9,065; U.S.S.R. 6,397.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals thousand tons	694	1,180	Netherlands 597; France 228; Belgium-Luxembourg 76.

[r]Revised. NA Not available.

Table 4.—Federal Republic of Germany: Mineral trade with the United States, 1976[1]

Commodity	Exports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
METALS				
Aluminum metal including alloys	4,779	$8,229	9,020	$15,999
Copper metal including alloys	28,547	51,187	26,440	44,155
Ore and concentrate	--	--	392	235
Iron and steel:				
Ore and concentrate	--	--	20	3
Metal:				
Scrap	55	82	22,539	8,880
Pig iron	350	530	211	319
Ferroalloys	7,498	9,412	2,271	2,501
Steel, primary forms	5,903	1,390	386	145
Semimanufactures:				
Bars and angles	189,442	50,404	25,788	6,842
Plates and sheets	412,626	125,594	6,345	3,196
Hoop and strip	17,145	11,569	15,493	6,121
Rails	621	196	1	1
Wire	9,303	8,191	289	675
Tubes and pipes	41,291	35,571	2,008	4,890
Castings and forgings	2,744	3,594	494	1,452
Lead metal including alloys	67	121	47	153
Ore and concentrate (lead-zinc)	--	--	22,793	3,568
Molybdenum ore and concentrate	--	--	3,651	21,245
Nickel metal including alloys	2,345	13,779	6,823	38,090
Platinum-group metals and silver:				
Ores	([2])	485	99	2,645
Metals:				
Platinum-group	1	4,101	2	5,709
Silver metal including alloys	NA	23	36	3,060
Radioactive and associated materials	85	3,346	1,167	114,987
Tin metal including alloys	211	1,654	5	23
Uranium metal including alloys	--	--	NA	4
Concentrates (uranium and thorium)	--	--	NA	4
Zinc metal including alloys	43,258	33,045	31	102
Ore and concentrate	202	102	--	--
Other nonferrous metals:				
Ores and concentrates, n.e.s	NA	442	5,030	3,353
Metals:				
Base metals including alloys, n.e.s	1,177	15,840	4,611	31,535
Scrap	15,389	8,875	26,942	16,852
NONMETALS				
Abrasives, natural, including diamond	4,750	236	16,436	11,315
Asbestos, all forms	1,738	383	628	683
Cement	412	58	--	--
Clays and refractory materials	1,329	551	247,555	20,490
Diamond and precious stones:				
Industrial diamond	NA	52	--	--
Gem diamond and precious stones	20	13,193	47	9,718
Lime	5	3	--	--

See footnotes at end of table.

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Table 4.—Federal Republic of Germany: Mineral trade with the United States, 1976[1] —Continued

Commodity	Exports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
NONMETALS —Continued				
Fertilizer materials:				
Crude, phosphatic	--	--	587,999	15,652
Manufactured, potash	24,059	2,446	--	--
Potassium nitrate, crude	NA	1	--	--
Ammonia, anhydrous	--	--	(2)	10
Oxygen, nitrogen, rare gases	--	--	54	363
Quartz, mica, feldspar, etc	1,166	406	401	259
Salt, sodium chloride	471	143	--	--
Stone, sand and gravel:				
Dimension stone	227	269	--	--
Crushed and broken stone, sand and gravel	2,008	87	3,173	1,077
Sulfur:				
Sulfur and unroasted pyrites	61	20	176	4
Sulfuric acid	2,589	68	4	15
Other, crude	30,462	4,235	2,504	980
MINERAL FUELS AND RELATED MATERIALS				
Asphalt, natural	--	--	7,198	1,124
Coal, all types	7,901	641	907,384	46,605
Coke	799,601	83,419	71,159	2,443
Gas, natural, manufactured	6	6	--	--
Petroleum:				
Refinery products:				
Residual fuel oil	72,978	4,241	--	--
Lubricants	656	418	21,900	10,139
Petroleum jelly and mineral waxes	7,513	5,912	23,524	4,894
Petroleum coke, asphalt, etc	118	20	563,021	32,099
Total	XX	504,570	XX	494,609

NA Not available. XX Not applicable.
[1]Data may differ from those reported elsewhere in this chapter owing to a difference in source.
[2]Less than 1/2 unit.

Source: U.S. Department of Commerce, Bureau of the Census.

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COMMODITY REVIEW

METALS

Aluminum.—Reynolds Aluminium Deutschland, Inc. (RADI) concluded an installment purchase agreement with the city of Hamburg for the acquisition of the city's share of their jointly owned plant.

Vereinigte Aluminium Werke completed plans to rebuild its 55,000-ton-per-year Töging reduction plant. When work is completed in 1980, at a cost of $90 million, the plant's capacity will be 71,000 tons per year.

Production of primary and secondary aluminum increased in 1977; production costs also increased because of the higher cost of energy used in the production process. Average utilization of reduction plant capacity in 1977 was 98%. The FRG remained a net importer of aluminum metal.

In 1977, 10 reduction plants with a total nominal capacity of about 762,000 tons per year were operated. Approximately one-half of the country's aluminum supply was domestically produced primary metal, about one-quarter was secondary metal of domestic origin, and the rest was imported.

FRG primary aluminum producers, with plant capacity at the end of 1977, are shown in the following tabulation:

Company, ownership (in parentheses), and plant location	Yearend capacity 1977 (thousand tons)
Aluminium-Hütte Rheinfelden GmbH (Swiss Aluminium Co.[1]), Rheinfelden, Baden	64
Gebrüder Giulini GmbH, Ludwigshafen	45
Kaiser-Preussag Aluminium GmbH (Preussag AG 50%; Kaiser 50%), Voerde, Duisburg	72
Leichtmetall GmbH (ALUSUISSE), Essen-Borbeck	130
Hamburger Aluminium-Werke GmbH (Reynolds), Hamburg	100
Vereinigte Aluminium-Werke AG (Government); Erftwerk, Grevenbroich	36
Innwerke, Töging	55
Lippenwerke, Lünen	50
Stüttgen Bei Neuss, Rheinwerk	145
Elbewerk, Stade	65
Total	762

[1]ALUSUISSE.

FRG alumina producers, with plant capacity in 1977, are shown in the following tabulation:

Company, ownership (in parentheses), plant, and location	Capacity in 1977 (thousand tons)
Vereinigte Aluminium-Werke AG-VAW (Government): Lippenwerk, Lünen	430
Nabwerk, Schwandorf	210
Aluminium Oxid Stade (VAW 50%; Reynolds 50%), Elbewerk, Stade	600
Martinswerk GmbH für Chemische und Metallurgische Produktion (ALUSUISSE 92%), Bergheim	350
Gebrüder Giulini GmbH, Ludwigshafen	140
Total	1,730

Iron Ore.—The FRG's small iron ore production increased slightly in 1977. Local steel mills continued to rely on richer and cheaper imported ores.

At the end of 1977, Stahlwerke Peine-Salzgitter AG closed its Legende mine in Lower Saxony. The mine had produced 1.5 million tons of crude ore in 1977. The closing of the mine left the country with four iron ore mining companies and only six operating iron ore mines, as follows: Salzgitter Erzbergbau AG with a mine at Haverlahwiese, Barbara Rohstoffbetriebe mbH with mines at Fortuna and Wohlverwahrt-Nammen, Eisenwerk-Gesellschaft Maximilianshütte mbH with mines at Auerbach and Sulzbach-Rosenberg, and Stahlwerke Peine-Salzgitter AG with a mine at Bülten-Adenstedt.

Iron and Steel.—The worldwide economic recession and overcapacity in every major steel-producing country had a strong effect on the FRG's steel industry in 1977. Production was lower than at any time during the last decade, and the industry operated at only approximately 60% of capacity. Losses were around $200 million for the Dutch-FRG-Estel-Hoesch-Hoogovens Group, $130 million for Klöckner-Werke AG, and $90 million for Stahlwerke Röchling-Burbach GmbH in the Saar. Only the Thyssen Group, the world's ninth largest steel producer and Europe's largest privately owned steel company, managed to avoid an operating deficit.

A rationalization plan was prepared for the steel industry of the Saar, led by the Luxembourg-based Acíeries Réunies de Burbach-Eich-Dudelange (ARBED) concern.

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The plan is expected to eliminate 8,800 jobs by 1983. To counteract possible unemployment, the Federal and the State Governments concurrently approved a Special Program for the Saar, creating new jobs outside the steel industry. In the program about $100 million was earmarked for 1978-81, and about 15,570 new jobs were to be created.

Klöckner Werke decided to cut its workforce by about 1,500 persons at its Georgsmarienhütte and Maxhütte works in Bremen. There had been short shifts at the company since February 1977.

Mannesmann-Röhren-Werke inaugurated a 1.1-million-ton-per-year large-diameter pipe mill at Mühlheim near Cologne.

It was reported that Stahlwerke Röchling-Burbach increased its holdings in Lech-Stahlwerke, the former Bayerische Elektrostahlwerke, to slightly over 89%.

Thyssen AG ordered from Krupp-Koppers GmbH an iron-ore-sintering plant with 250 square meters of surface and a capacity of 10,000 tons per day. The plant, valued at over $50 million, was to be located in Duisburg-Schwelgen.

FRG steel companies continued to be heavily involved in the Brazilian steel industry, both as owners and operators of steelmaking facilities and as suppliers of equipment for Brazilian steel plants. Companies involved included Mannesmann AG and Thyssen, both of Düsseldorf, Friedrich Gustav Theis Kaltwalzwerke GmbH of Hohenlimburg, Gutehoffnungshütte Sterkrade AG of Oberhausen, and Schloemann-Stemag AG and Maschinenfabrik Sack GmbH, both also of Düsseldorf.

In 1977, major FRG steel producers and approximate steelmaking capacities were as shown in the following tabulation:

Company	Capacity (million tons per year)
August Thyssen-Hütte AG	16.5
Hoesch AG	7.2
Klöckner-Werke AG	7.2
Peine-Salzgitter AG	6.3
Friedrich Krupp GmbH	4.5
Mannesmann AG	4.5
Stahlwerke Röchling-Burbach GmbH	2.8
AG der Dillinger Hüttenwerke	2.0
Neunkircher Eisenwerk AG	1.3

Lead, Zinc, Silver, Copper.—Preussag AG ordered short-shift work at its Grund and Rammelsberg mines and its Harz smelter in Lower Saxony. Reason for the measures was a collapse of zinc prices and demand.

Metallgesellschaft AG, also under the influence of the zinc market slump, ordered cutbacks in the output of its Ruhr zinc smelters, including the Duisburg and Datteln electrolytic plants.

At the end of 1977, four lead and zinc mines and five concentrators continued to operate in the FRG. In 1977, about 2 million tons of ore with 7% lead and zinc was mined. About one-half the lead-zinc ore was produced by Preussag AG in the Harz region, about 40% by Sachtleben Bergbau GmbH at Lennestadt in North Rhine-Westphalia, and 10% by AG Altenbergs für Bergbau und Zinkhüttenbetrieb at Lüderich near Cologne.

Zinc smelters and capacities at the end of 1977 are shown in the following tabulation:

Company and plant location	Type	Annual slab zinc capacity (thousand tons)
Berzelius Metallhütten GmbH, Duisburg-Wanheim.	Imperial	80
Duisburger Kupferhütte GmbH, Duisburg.	Electrothermic	20
Preussag-Weser-Zinc GmbH:		
Harlingerode	Vertical retort.	95
Nordenham	Electrolytic	110
Ruhr-Zinc GmbH, Datteln	do	130
Total		435

Lead smelting and refining works and capacities at the end of 1977 are shown in the following tabulation:

Company	Plant location	Annual refined lead capacity (thousand tons)
Berzelius Metallhütten GmbH	Duisburg-Wanheim.	[1]35
	Braubach	70
	Binsfeld-hammer.	80
Norddeutsche Affinerie	Hamburg	45
Preussag-Boliden-Blei GmbH	Nordenham	120
Preussag AG Metall	Oker (Harz)	45
Total		395

[1]Smelter only; bullion shipped to the company at Braubach.

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The country's lead-zinc mines also produced moderate amounts of copper and silver as byproducts. Domestic copper and imported materials were processed and refined mainly in Norddeutsche Affinerie's 215,000-ton Hamburg refinery, Duisburger Kupferhütte's 30,000-ton Duisburg smelter, and Hüttenwerke Kayser AG's 15,000-ton Lünen smelter. There were also several smaller copper smelters and refiners.

Silver production was processed mainly at Preussag-Boliden-Blei GmbH's Nordenham lead smelter and Berzelius Metallhütten GmbH's Duisburg-Wanheim refinery.

NONMETALS

Barite.—In September 1977, the world's largest barite mine, Sachtleben Bergbau GmbH's Meggen facility near Lennestadt in central Germany, was closed owing to depletion of ore.

At the end of 1977, the FRG had six operating barite mines. Deutsche Baryt Industrie and Sachtleben controlled two each, and Feldhaus Schwerspatgrube GmbH and Preussag AG Metall controlled one each.

Cement.—After a slight increase during 1976, FRG cement consumption fell 4.8% in 1977, owing to a continued slump in the building industry. In 1977, the FRG, including West Berlin, operated 71 cement plants controlled by 42 individual companies.[4]

Fertilizer Materials.—*Nitrogen.*—Nitrogen production decreased further in 1977. Ammonia production ran at about 77% of capacity. Companies engaged in the production of ammonia, with their plants and capacity in 1977, are shown in the following tabulation:

Company	Plant location	Approximate capacity (thousand tons per year)
Badische Anilin und Soda Fabrik AG (BASF)	Ludwigshafen	800,000
Erdölchemie (Bayer, BP)	Cologne	300,000
Gewerkeschaft Viktor Chemische Werke	Castrop-Rauxel.	250,000
Hoesch AG	Frankfurt	115,000
Rheinische Braunkohlen-werke (URBK)	Wesseling	[1]360,000
VEBA-Chemie AG	Bottrop	145,000
	Herne	240,000
	Gelsenkirchen-Scholven.	400,000
	Brunsbüttel	[2]400,000

[1]In planning stage.
[2]Startup in 1978.

Source: Petroleum Times. V. 81, No. 2060, Sept. 30, 1977, pp. 51-53.

Phosphate.—Production of phosphate ore in the FRG ceased following the permanent closure of Stahlwerke Peine-Salzgitter AG's Legende iron ore mine at yearend 1977.

Potash.—As a result of a slight improvement in the international potash market, the FRG's potash production and sales improved somewhat but still remained lower than total capacity.

About 91% of potash output was produced by the nine potash mines of Kali und Salz AG: Bergmannsegen-Hugo, Hattorf, Neuhof-Ellers, Niedersachsen-Riedel, Salzdetfurth, Siegfried-Giesen, Sigmundshall, Wintershall, and Hope. The Hope a, small mine, is expected to be depleted by 1980, and its production and personnel were combined with those of the Sigmundshall mine. The second largest potash company, Kali-Chemie AG, accounted for the remaining 9% of the country's potash production at its Friedrichshall mine. All the FRG's potash mines were located in the Hannover area with the exception of Wintershall and Hattorf, which were east of Kassel on the East German border, and Neuhof-Ellers, which was near Fulda.

Fluorspar.—In 1977, fluorspar production increased. The domestic product supplied most of the FRG's chemical and ceramic industries. Metallurgical-grade spar was mainly imported. There were nine fluorspar mines in the FRG in 1977, operated by three companies: Flussspat Bergbau Paul Freitag (one mine); Fluss- und Schwerspat Werke Pforzheim (five mines); and VAW Flussspat-Chemie GmbH, Stulln (three mines). Almost all the mines were

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located in Bavaria and Baden-Württemberg.

Salt.—Salt production increased in 1977 due to greater foreign and domestic demand for salt used in deicing roads. In 1977, 10 companies controlled 14 salt mines in the FRG: 8 of the mines produced rock salt, and the remaining 6 produced brine by solution mining. Kali und Salz controlled the rock salt mines of Mariaglück, Niedersachsen-Riedel, and Braunschweig-Lüneburg located in the Hannover area. Südwestdeutsche Salzwerke AG controlled the solution mine and refinery of Friedrichshall-Kochendorf and the Heilbronn rock salt mine in northern Baden-Württemberg. Deutsche Solvay Werke GmbH controlled Borth, a rock salt mine located in the western Ruhr area. Wacker Chemie AG controlled the Stetten rock salt mine, located south of Stuttgart, and Bayerische Berg-, Hütten- und Salzbergwerk AG controlled the Berchtesgaden rock salt mine, located on the border with Austria.

The following salt mines were all of the solution-mining type: Dow Chemical GmbH's Stade mine, northwest of Hamburg; Norddeutsche Salinen GmbH's Lüneburg mine, south of Hamburg; Salzgewinnungsgesellschaft Westfalen mbH's Epe mine, near the Netherlands border; Bartold Levin GmbH & Co. KG's Luisenhall mine, near Göttingen; Bayerische Berg-, Hütten- und Salzbergwerke AG's Reichenhall mine at Berchtesgaden; and Dynamit Nobel AG's Rheinheim mine on the Swiss border.

MINERAL FUELS

Domestic coal, coke, natural gas, and crude oil supplied about 38% of FRG's energy requirements. Imported petroleum, natural gas, and nuclear power accounted for the remaining portion.

Energy-saving measures instituted by the Government in 1977 included the doubling of the tax on heating oil to 3.8 cents per gallon, and $2 billion was allocated for various other measures for the 1978-82 period. A law on modernization of housing is to grant subsidies to homeowners for energy-saving installations.

Supply and apparent consumption of fuel and power in the FRG in 1976 and 1977 are shown in table 5.

Table 5.—Federal Republic of Germany: Supply and apparent consumption of fuels and power

(Million tons of standard coal equivalent[1])

	Total energy	Coal and coke	Petroleum and refinery products	Natural gas	Fuelwood and peat	Hydroelectric power	Nuclear power[2]	Other[3]
1976:								
Production[4]	160.8	125.9	8.0	21.2	0.4	4.1	--	1.2
Imports	258.5	10.0	205.3	31.1	--	4.2	7.9	--
Exports	38.7	21.3	13.4	.1	--	3.9	--	--
Apparent consumption	380.6	114.6	199.9	52.2	.4	4.4	7.9	1.2
1977:								
Production[4]	154.2	118.9	7.8	20.7	.5	4.1	--	2.2
Imports	268.6	14.0	200.6	38.2	--	4.0	11.8	--
Exports	37.2	20.8	10.1	1.6	--	4.7	--	--
Apparent consumption	385.6	112.1	198.3	57.3	.5	3.4	11.8	2.2

[1]1 ton standard coal equivalent (SCE) = 7 million kilocalories.
[2]Produced domestically from imported nuclear fuel.
[3]Includes solid wastes, refuse, waste heat, and steam for generating power.
[4]Includes only primary energy.

Sources: Verlag Glückauf, Essen. Jahrbuch für Bergbau, Energie, Mineralöl und Chemie, 1978/79. V.89. Mineralölstatistik der Bundesrepublik Deutschland 1977. Feb. 24, 1978. Aussenhandel nach Waren und Länden. December and year 1977. Produzieren des Gewerbe. December 1977.

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Coal.—In 1977, coal production (bituminous and anthracite) fell further while sales decreased from 88.8 to 80 million tons. At the mines stocks of coal and coke grew by yearend to about 7 million tons and 12 million tons, respectively. The extremely weak demand for coal from steel mills, compounded by low economic growth and unfavorable weather conditions, accounted for the poor sales performance in 1977. There were no indications of a major improvement in the situation in the near future. Lasting recovery is hoped for only in the early or mid-1980's and if there is a worldwide energy shortage.

Lignite production decreased also in 1977. Development continued at Rheinische Braunkohlenwerke AG's Hambach mine.

Financial aid for the coal industry amounted to about $2 billion per year, including an approximately $1 billion surcharge paid by German electric power consumers to the utilities for the use of domestic coal in powerplants. Furthermore, the amount of public subsidies is expected to accelerate with an eye to promoting the use of such coal by the steel mills of the European Community.

Ruhrkohle AG converted its Hansa mine, located near Dortmund, to all-hydromechanical operation at a cost of about $60 million. Water is used to mine and transport coal to the surface.

The mines and steelworks of the Saar plan to build a central coking plant of 1.6 million tons per year capacity; construction costs are expected to be $300 million.

In 1977, there were 43 coal mines, 21 coking plants, 5 briquetting plants, and 29 mine-mouth powerplants in the country.[5] The industry was controlled mainly by seven companies: Three in the Ruhr, two in the Aachen area, and one each in Saarland and Lower Saxony. The largest industrial group was Ruhrkohle AG, controlling about three-quarters of the country's output.

The lignite industry was dominated by the Rheinische Braunkohlenwerke AG, which accounted for nearly four-fifths of total output; the remaining production came from two medium-sized and four smaller companies.

The FRG's bituminous coal reserves were estimated in 1974 at 44 billion tons, of which 30 billion tons was recoverable. Total resources were set at 230.3 billion tons. Known lignite reserves were placed at 55.5 billion tons, of which 9.5 billion tons was recoverable. Total resources were set at 55.9 billion tons.[6]

Nuclear Power.—The FRG's nuclear powerplants supplied one-third more electricity in 1977 than in 1976. The rise was due to the fact that this was the first complete operational year for the Biblis B, GKN-I, and KKB reactors. The KKI reactor, commissioned by yearend, contributed only a small amount. Two other plant completions that went on-line included KKU Unterweser (1,300 MWe) and KKP-1 Philippsburg (900 MWe).

In December 1977, the following 14 nuclear reactors were in operation in the FRG:

Name	Location	Capacity, nominal (Megawatts electrical)
VAK	Kahl	15
MZFR	Karlsruhe	57
KRB	Grundremmingen	252
AVR	Jülich	15
KWL	Lingen	168
KWO	Obrigheim	345
KKS	Stade	622
KWW	Würgassen	670
KNK	Karlsruhe	21
Biblis A	Biblis	1,204
Biblis B	do.	1,300
GKN-1	Neckarwestheim	855
KKB	Brunsbüttel	806
KKI	Isar	907

In addition, 12 plants with a total capacity of 14,360 MWe were under construction, and 12 plants totaling 15,229 MWe in capacity were in the planning stage.

Total uranium (fuel) requirements of the FRG's nuclear plants for 1977-86 were 33,000 tons, 22,000 tons of which have been secured through supply contracts. In 1978, 65% of the enriched uranium is to come from the United States and 35% from the U.S.S.R. In 1986, 45% is to come from the United States, 35% from URENCO Ltd., a European consortium for enriching uranium, 15% from the U.S.S.R., and 5% from unspecified sources.[7]

Uranium stockpiles in 1977 included 2,000 tons of natural uranium and 2,460 tons of enriched uranium. An agreement concluded in 1977 between Canada and FRG utilities covered 29% of natural uranium requirements for the next decade. In 1977-80, the Republic of South Africa was to supply 4,200 tons of natural uranium, Canada 2,200 tons, France, Gabon, and Niger 1,500 tons, the United States 600 tons, and the others 500 tons.

In 1977, the FRG allocated funds totaling

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about $1 billion to nuclear energy.

Two FRG companies, helped by Government loans, have sustained an intensive worldwide activity in prospecting for uranium and have secured to a great extent the country's uranium supply. One was Uranerzbergbau GmbH (Bentheim), founded in 1968 by C. Deilmann AG and Rheinische Braunkohlenwerke AG; the other was Urangesellschaft mbH (Frankfurt am Main), founded in 1967 by Metallgesellschaft AG, Steag AG, and VEBA AG.

Prospecting for uranium was in the hands of three companies. Gewerkschaft Brunhilde has operated since 1959 a uranium-processing plant at Ellweiler in Rheinland-Pfalz, producing 50 tons of uranium oxide (U_3O_8) per year from local ores; present ores mined during prospecting at Mezenschwand (Black Forest) are processed at a rate of 150 tons of U_3O_8 per year. Esso-Erz GmbH held uranium concessions in Bavaria, Baden-Württemberg, and Hesse, was prospecting in the Black Forest area, and announced a uranium discovery in the Upper Pfalz. Saarberg-Interplan was prospecting for uranium in Baden-Württemberg, Bavaria, Hesse, Rheinland-Pfalz, and the Saar. In 1975, the company discovered a uranium deposit at Müllenbach in the Murg Valley (Black Forest).

Oil Shale.—Braunschweigische Kohlen Bergwerke planned to build a small-size opencast mine for mining oil shale at Schandelah, located between Braunschweig, Wolfsburg, and Helmstedt, where an estimated 100 million tons of oil is contained in 2 billion tons of shale.

Petroleum and Natural Gas.—There were several important events in the FRG oil and gas industry in 1977.

A new oilfield was found at Neumarkt-St. Veith, 70 kilometers east of Munich. The claim belongs to the Bavarian Minerals Consortium composed of Mobil Oil AG, Gewerkschaft Elwerath, and Preussag AG.

In September 1977, natural gas started to flow from the Norwegian Ekofisk oil and gas fields through a 440-kilometer-long 36-inch pipeline to a gas processing plant, located in Emden on the Ems estuary. The startup of the pipeline was delayed by the approval of the Danish Government, requiring the burying of the pipeline into the sea floor. The Emden gas-processing plant will handle 17 billion to 18 billion cubic meters of North Sea gas per year. Eight billion cubic meters of clean gas are to be delivered to Ruhrgas AG, and the rest will be divided equally among Nederlandse Gasunie (Netherlands), Distrigaz S.A. (Belgium), and Gaz de France.

In 1977, FRG natural gas production increased to 19.5 billion cubic meters, and natural gas imports rose to 31.7 billion cubic meters. Natural gas reserves of the FRG were 185 billion cubic meters.[8]

Deutsche Marathon Petroleum GmbH sold its 40% interest in Erdölraffinerie Mannheim GmbH (ERM) to Wintershall AG, which held the other 60%. ERM owned and operated a 5.6-million-ton-per-year oil refinery in Mannheim.

No commercial oil or gas was found in the FRG sector of the North Sea where the Deutsche Nordseegruppe/BP AG has drilled 40 holes costing $300 million since 1964.

Domestic crude oil production was maintained by the successful use of secondary and tertiary recovery methods as well as extension wells and additional production wells in many oilfields; domestic production supplied only about 4% of domestic demand. Drilling totaled about 242 kilometers in 1977. Proved oil reserves decreased to 42.4 million tons.[9]

With demand stagnating in 1977, the FRG remained Western Europe's largest consumer of crude oil and petroleum products with about 123 million tons of domestic sales.[10]

Imports of crude oil and petroleum products amounted to approximately 139 million tons in 1977. About 78.4 million tons of crude oil including minor quantities of processed oil were imported through five pipelines: Trieste-Ingoldstadt-Karlsruhe (TAL); Wilhelmshaven-Rhine (NWO); Rotterdam-Rhine (RRP); Marseilles-Karlsruhe, Wörth, Speyer-Saarbrücken (SEPL); and Genoa-Ingolstadt (CEL).

Liquid natural gas imports of 8 billion cubic meters per year were the subject of a 20-year contract concluded between a consortium composed of Ruhrgas AG and Salzgitter Ferngas GmbH, both of the FRG; the Nederlandse Gasunie (Netherlands); and the Algerian state company, Sonatrach. Deliveries by Algeria to Wilhelmshaven and Rotterdam (the Netherlands) were to start in 1984.

In 1977, the FRG's petroleum-refining capacity increased slightly owing to an increase by 1.2 million tons at the Saarland Raffinerie GmbH in Völklingen, and minor decreases in the ratings of several other refineries. Yearend capacity (throughput) of FRG refineries is shown in the tabulation following.

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[1]Physical scientist, Branch of Foreign Data.
[2]U.S. Department of State. Foreign Economic Trends and Their Implications for the Federal Republic of Germany. May 1978.
[3]Where necessary, values have been converted to U.S. dollars from Deutsche marks (DM) at the rate of DM2.531 = US$1 for 1977 (International Monetary Fund).
[4]The European Cement Association. World Cement Directory, 1977. pp. 200-211.
[5]Statistik der Kohlenwirtschaft E.V. Zahlen zur Kohlenwirtschaft. No. 111, March 1978, p. 17.
[6]Jahrbuch für Bergbau, Energie und Chemie 1977/78.
[7]ATW News (Düsseldorf). ISSN 034-4213, February 1978, p. 4.
[8]World Oil. V. 187, No. 3, Aug. 15, 1978, p. 141.
[9]World Oil. V. 187, No. 3, Aug. 15, 1978, p. 141.
[10]Stahl und Eisen (Düsseldorf). V. 98, No. 3, Feb. 9, 1978.

Ownership	Location	Capacity (million tons per year)
Caltex Deutschland GmbH	Raunheim	4.5
Deutsche BP AG	Hamburg-Finkenwerder	5.1
Do	Dinslaken	9.9
Do	Vohburg	5.1
Deutsche Marathon Petroleum GmbH	Burghausen	3.2
Deutsche Shell AG	Hamburg-Harburg	4.3
Do	Monheim	.5
Do	Godorf	9.0
Do	Ingolstadt	2.8
Deutsche Texaco AG	Heide	5.6
Elf Bitumen-Werke GmbH & Co.	Brunsbüttel	.5
Erdölraffinerie Duisburg GmbH	Duisburg-Neuenkamp	2.0
Erdölraffinerie Ingolstadt AG	Ingolstadt	7.0
Erdölraffinerie Mannheim GmbH	Mannheim	5.6
Erdölraffinerie Neustadt GmbH	Neustadt	7.0
Erdölwerke Frisia AG	Emden	2.4
Esso AG	Hamburg-Harburg	5.5
Do	Cologne	5.7
Do	Karlsruhe	8.0
Do	Ingolstadt	5.0
Fina Bitumenwerk GmbH	Mülheim	.5
Gewerkschaft Erdölraffinerie Deurag-Nerag	Misburg	2.3
Mobil Oil AG	Wilhelmshaven	8.0
Do	Wörth	3.5
Oberrheinische Mineralölwerke GmbH	Karlsruhe	7.0
Oelwerke Julius Schindler GmbH	Hamburg-Neuhof	.4
Saarland Raffinerie GmbH	Völklingen	3.6
Union Rheinische Braunkohlen Kraftstoff	Wesseling	6.0
VEBA-Chemie AG	Gelsenkirchen-Horst	[1]7.0
Do	Gelsenkirchen-Scholven	[2]10.0
Wintershall AG	Lingen	4.5
Do	Salzbergen	.3
Total		154.5

[1]1.5 million tons were out of operation.
[2]2.5 million tons were out of operation.

Source: German Oil Information Service, Hamburg. V. 31, No. 16, Jan. 30, 1978, p. 2.

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The Mineral Industry of Ghana

By T. John Rowland, Jr.[1]

The mineral industry of Ghana in 1977 consisted of the production of bauxite, gold, manganese ore, cement, and diamond. Aluminum, manufactured from imported alumina, and petroleum products, based on imported crude oil, were also included in 1977 mineral production. World and national economic conditions, as well as severe weather conditions that hampered alluvial mining, resulted in decreased bauxite, diamond, gold, and manganese production in 1977. A slight increase was registered in aluminum production from the smelter at Tema.

The Government's 5-year development plan, first presented in 1975, was implemented in 1977 after a series of postponements. The stated objectives of the plan included accelerating the rate of real domestic growth, utilizing more human and natural resources, controlling inflation and the distribution of income, and promoting national economic independence. Total expenditure for the plan was $5.8 billion.[2] The mineral industry was allotted $291 million for expansion and revitalization. About one-third of the cost was to be financed by the Government.

During 1977, Ghana experienced a rapid rise in the rate of inflation. The primary cause was a large Government budget deficit reported at 50% above expenditures. To counteract the situation, various measures were introduced, including relaxation of import controls and initiation of a 20% export bonus on the value of minerals.

The mineral industry remained besieged by rising costs, high taxation, and inadequate transportation facilities inhibiting the shipment of manganese and bauxite ores. Foreign exchange constraints and uncertainty about Government policy toward foreign investors resulted in a decrease in new mining investments.[3] In addition to other economic difficulties, the basic miners wage tripled during the first half of 1977, owing to the imposition of new minimum wage laws.[4]

In the Eastern Region on the Volta River at Kpong, construction of the 160-megawatt Kpong dam and hydroelectric power system began during the second half of 1977. Loans for the $280 million Kpong project were secured from the International Bank for Reconstruction and Development (IBRD), $57 million; the Canadian International Development Agency (CIDA), $35 million; the Kuwaiti Government, $26.7 million; and the Arab Bank for Economic Development in Africa (ABEDA), $10 million.

The Investment Policy Decree of April 1975 was enacted on January 1, 1977. As outlined in the Decree, the mineral industries (except oil and bauxite) were to become 55% Ghanaian if valued above $435,000 and 40% Ghanaian if valued below that level. Government interest in bauxite mining and alumina processing was not to exceed 30%, and its interest in the petroleum industry was not to exceed 20%. Most small commercial and industrial firms were to be completely nationalized.

PRODUCTION AND TRADE

Mineral production as a whole, excluding petroleum refining, decreased in 1977. Individual decreases included bauxite 10%, gold 10%, manganese ore 7%, cement 6%, and

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diamond 15%. Aluminum metal was the only commodity to register an increase.

Diamond Marketing Corp. (DMC), a Government-owned company, was responsible for marketing Ghana's diamond. DMC held three auctions during 1977 which were open only to firms and individuals registered with DMC. As throughout the past decade, the People's Republic of China bought about 13% of diamond production. The average price at the March sale was $6.50 per carat, an increase of $1.30 over the corresponding 1976 price.[5]

Despite the decrease in production, the value of gold produced in 1977 increased nearly 8% over that of 1976. As the most valuable Ghanaian mineral commodity, gold accounted for $94.6 million in exports.[6]

The Ghana Supply Commission remained the only importer of petroleum and the chief exporter of petroleum products. Crude petroleum was imported primarily from Nigeria, with lesser amounts from Libya and the U.S.S.R. Ghana's annual oil cost has risen steeply in recent years to $150 million, which has intensified the country's search for domestic sources of petroleum.[7]

Table 1.—Ghana: Production of mineral commodities

Commodity[1] and unit of measure	1975	1976	1977[p]
METALS			
Aluminum:			
Bauxite, gross weight ---- metric tons	319,526	271,563	244,217
Metal, smelter, primary ---- do	143,220	151,391	153,468
Gold ---- thousand troy ounces	524	532	481
Manganese ore and concentrate, gross weight ---- metric tons	370,805	311,872	291,585
NONMETALS			
Cement ---- thousand metric tons	688	[r] [e]650	610
Diamond:			
Gem ---- thousand carats	233	228	230
Industrial ---- do	2,095	2,055	[e]1,717
Total ---- do	2,328	2,283	1,947
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline ---- thousand 42-gallon barrels	2,154	1,890	1,928
Kerosine ---- do	795	732	747
Jet fuel ---- do	364	385	392
Distillate fuel oil ---- do	2,549	2,482	2,531
Residual fuel oil ---- do	2,811	2,440	2,589
Other ---- do	--	98	92
Refinery fuel and losses ---- do	445	466	384
Total ---- do	9,118	8,493	8,663

[e]Estimate. [p]Preliminary. [r]Revised.

[1]In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone) are also produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

COMMODITY REVIEW

METALS

Aluminum.—Bauxite deposits, accounting for 2.5% of total world reserves, were located in the areas of Nyinahin, Awaso, and Kibi. Reserves at the Nyinahin deposit, located in central Ghana, were estimated at 580 million tons of ore. In western Ghana, reserves of 20 million tons of ore were estimated at the Awaso deposit. The Kibi bauxite deposit, located approximately 80 kilometers from the coast, had reserves of 182 million tons of ore.[8]

The feasibility of development of the large Nyinahin bauxite deposit was studied by Chemokomplex/Aluteru of Hungary, with the objective of establishing a fully integrated aluminum industry in the area. Additionally, Chemokomplex was to appraise the feasibility study conducted by Bauxite and Alumina Study Co. Ltd. (BASCOL), a dissolved consortium, on construction of an alumina refinery in the Kibi region. The 600,000-ton-per-year alumina plant was to begin production in the 1980's.

Ghana Bauxite Co. Ltd. (GBC) operated Ghana's only bauxite mine at Awaso. The 500,000-ton-per-year mine was jointly owned by the Government 55% and British Aluminium Co. Ltd. 45%. In 1977, Ghana

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possessed three of the five stages of aluminum production—mining, smelting, and fabrication—but did not yet produce alumina or have a rolling mill. Problems associated with insufficient railroad facilities from Awaso to the port at Takoradi continued to hinder production throughout the year.

Volta Aluminum Co. Ltd. (VALCO), owned by Kaiser Aluminum & Chemical Corp. 90% and Reynolds Metals Co. 10%, operated a 198,000-ton-per-year aluminum smelter at Tema. The smelter produced 153,000 tons of aluminum ingots from imported alumina in 1977. In early July, a nationwide power failure closed three of the five smelter potlines. The power failure was apparently owing to an overload on the Akosombo hydroelectric system. Three months were required to repair the damaged potlines and resume operations.[9]

A consortium led by Mitsubishi Metal Corp. of Japan was conducting a feasibility study for a second smelter of 200,000- to 300,000-ton-per-year capacity at Tema. A tentative agreement was reached between Hunter Engineering Co. of the United States and the Government to establish and operate a casting, rolling, and finishing plant at Tema, which was expected to process the VALCO aluminum ingots.

Gold.—Ashanti Goldfields Corp. (Ghana) Ltd., owned by State Gold Mining Corp. (GMC) 55% and Lonrho Ltd. of the United Kingdom 45%, operated a 259-square-kilometer concession in the Bakwai and Obuasi districts of the Ashanti Region. The mine extended over 16,000 feet along the strike of the ore body, with seven main surface shafts and three main internal shafts. Gold reserves in 1976 were estimated at over 3.6 million tons of ore with an average grade of 24 grams per ton. In 1977, the mine produced 340,229 troy ounces of gold. The company announced plans for construction of a new shaft at a cost of $3.3 million. Upon completion of the shaft in 4 years, the effective working depth of the mine is expected to be increased by 1,000 feet at each stage.

Dunkwa Goldfields Ltd., a subsidiary of GMC, ceased production early in the year because the alluvial dredges ordered in 1975 were not ready for delivery, although they were near completion. Gold reserves for the alluvial mine were estimated at 327 million cubic yards of ore. Tarkwa Goldfields Ltd. and Prestea Goldfields Ltd., subsidiaries of GMC, produced 56,269 troy ounces and 79,649 troy ounces of gold, respectively.[10]

The Government initiated feasibility studies for reopening the abandoned mines at Akrokerri, Maupambue, and Obenemasi. Prospecting and dredging operations for alluvial gold were to be intensified by GMC along the banks of the Bonte, Fure, and Bonsu Rivers.

Iron and Steel.—Construction of a $522 million iron and steel complex near Sekondi was started by the Government with technical assistance provided by Fried. Krupp GmbH (Federal Republic of Germany). The new complex was designed with a capacity of 200,000 tons per year of iron ore. The estimated 30-million-ton iron ore reserves at Wuwuoso, north of Tarkwa in the Opon Mansi area, were to be exploited by open pit methods to supply the complex.[11]

Manganese.—The Nsuta manganese mine in western Ghana was operated by Government-owned Ghana National Manganese Corp. (GNMC). Since 1974, GNMC has purchased all manganese ore mined in Ghana, with Caemi International of the Netherlands serving as marketing agent. Manganese ore production decreased 6.5% in 1977. The open pit mine produced both high-grade manganese dioxide (40% to 47% manganese) and lower grade manganese carbonate (30% manganese) ores. Manganese dioxide production diminished because of ore depletion. GNMC planned construction of a concentrator for beneficiating the manganese carbonate ore.[12]

GNMC was to reevaluate the reserves and conduct a feasibility study for development of manganese carbonate ore. The ore was transported from the Nsuta mine to the port of Takorodi for export to 11 countries.[13]

NONMETALS

Clays.—A $6.9 million brick and tile factory at Prampram was expected to be completed and begin production in late 1977. The factory, built to meet the building requirements of the Greater Accra Region, was designed with an annual production capacity of 36 million tons of brick and tile.

Diamond.—Ghana Consolidated Diamonds Ltd. (GCDL) controlled 99% of 1977 diamond production. GCDL was jointly owned by the Government 55% and Consolidated African Selection Trust Ltd. (CAST) of the United Kingdom 45%. Approximately 90% to 95% of the diamond recovered was industrial quality. Production from GCDL mines at Akwatia in eastern Ghana was 1,946,587 carats. Reserves of the Ak-

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watia deposit were estimated at 11.5 million carats and were expected to be depleted in 5 years. GCDL began development of an area near the confluence of the Pra and Birim Rivers. The 64-square-kilometer area, with estimated reserves of 50 million carats, was to be mined at a rate of 2 million carats per year.[14]

MINERAL FUELS

Petroleum.—In 1977, Agri-Petco Inc. of Tulsa, Okla., discovered oil 9 miles off the coast near Saltpond in the Central Region. The three 9,000-foot wells drilled by the company in the Bonsu field were each rated at a minimum of 1,000 barrels per day of sulfur-free, 36° to 39° API gravity crude oil.

The Government granted prospecting licenses to Oxoco International (United States) and Aracca Petroleum for two offshore areas totaling 3,240 square kilometers. Offshore Hydrocarbons (United States) obtained exploration rights to 4,890 square kilometers of the Ghanaian continental shelf. The U.S. Government firm Overseas Private Investment Corp. agreed to insure oil company interests against political risks. Private investments in Ghanaian offshore oil exploration were reported at $35 million.[15]

Phillips Petroleum Co. relinquished the rights to 5,200 square kilometers of onshore and offshore concessions, and Oxoco surrendered a 3,440-square-kilometer offshore concession.

Shell Oil Co. abandoned the search for onshore oil in the Voltarian Basin of the Brong-Ahafo Region. Although promising petroleum findings were not reported, the geological knowledge of eastern Ghana was significantly expanded.

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[1]Physical scientist, Branch of Foreign Data.
[2]Where necessary, values have been converted from Ghanaian new cedi (Nc) to U.S. dollars at the rate of Nc1=US$1.00.
[3]Mining Annual Review (London). West Africa, Ghana. June 1978, p. 498.
[4]U.S. Embassy, Accra, Ghana. State Department Airgram A-54, May 22, 1978.
[5]U.S. Embassy, Accra, Ghana. State Department Airgram A-24, May 12, 1977.
[6]U.S. Embassy, Accra, Ghana. State Department Airgram A-56, June 2, 1978.
[7]U.S. Embassy, Accra, Ghana. State Department Airgram A-24, Apr. 17, 1978.
[8]International Bauxite Association. Focus on Member Countries, The Republic of Ghana. Quarterly Review, v. 3, No. 1, Sept. 30, 1977, p. 6.
[9]Mining Journal (London). Power Cut Hits Ghana Smelter. V. 290, No. 7446, May 5, 1978, p. 301.
[10]Work cited in footnote 3.
[11]Mining Journal (London). Work Begins on Ghana Iron-Steel. V. 289, No. 7419, Oct. 28, 1977, p. 282.
[12]Work cited in footnote 3.
[13]Work cited in footnote 4.
[14]Mining Engineering. Ghana's Consolidated Diamond Ltd. V. 29, No. 20, February 1977, p. 30.
[15]Petroleum Economist. Ghana. V. 49, No. 11, November 1977, p. 457.

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The Mineral Industry of Greece[1]

By Roman V. Sondermayer[2]

The mineral sector of the Greek economy, including processing, contributed about 6% to the country's gross national product (GNP) in 1977. The share of the mining and quarrying sector was only 1.3% of the total GNP. The growth of the mineral industry production index was higher than that of the rest of the economy because of strong government involvement in the mineral industry. The mineral industry employed an estimated 19,000 persons, or 0.6% of the total labor force.

Bauxite and the nonmetals were the most important minerals produced in Greece during 1977. Greek production of bauxite, magnesite, barite, perlite, and nickel was between 1% and 3% of world production. Output of other minerals was of only domestic significance.

During 1977, large government-sponsored mineral projects were underway, and the Government retained a major role in development of mineral wealth and the mineral industry through its own agencies and through government-controlled companies. Participation of foreign partners was welcome, but the foreign share in joint ventures was held under 50%.

In August 1978, Parliament passed Law No. 669 regulating the exploitation of quarries. This law requires use of modern methods of production and contains very strict provisions for safeguarding the environment.

During 1977, major events in the mineral industry were expansion of the capacity of bauxite mines at Parnassos-Ghiona in central Greece; modernization of the chromite beneficiation plant at Skoumtsa; closing of lead mines at Laurium; expansion of nickel-producing facilities at Euboea; beginning of construction of a 350,000-ton-per-year bentonite plant on Milos Island; and expansion of lignite mines at Megalópolis, Amynteon, and Ptolemais.

PRODUCTION

The mineral industry was privately owned, but the Government increased its activities in the field of mining and processing minerals through its own organizations, mostly publicly owned corporations. The principal ones were Public Power Corp. (PPC), the Public Petroleum Enterprise (DEP), Hellenic Industrial & Mining Investment Co. S.A. (HIMIC), Project Studies & Mining Development Corp. (GEMEE), and Geological and Mining Research Institute Activity (IGME). In addition, the Government was pushing ahead large investments using its own financial institutions such as the Hellenic Industrial Development Bank (ETVA).

The following tabulation shows major companies operating in Greece during 1977:

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Commodity	Major producers	Ownership	Principal facilities	Percent of output
Aluminum	Aluminium de Grèce S.A	Péchiney Ugine Kuhlmann (PUK) 73% and Government 27%.	Plant at Distomon, Boeotia.	100
Barite	Mykobar Mining Co. S.A	Dresser Industries Inc. (United States).	Mines on Mykonos Island.	50
Bauxite	Bauxite Parnasse Mining Co. S.A.	NA	Mines at Parnassos-Ghiona.	51
Cement	Titan Cement Co. S.A	NA	Plants at Eleusis, Patras, Thessaloniki, Kamari (Boeotia).	38
Chromite (metallurgical)	Project Studies and Mining Development Corp. S.A.	Hellenic Industrial Development Bank.	Mines at Kozáni	100
Chromite (refractory)	Financial Mining-Industrial and Shipping Corp. (FIMISCO).	Scalistiris Group	Mines at Vólos, Kozáni, Domokos.	100
Lead and zinc ores	Hellenic Chemical Products and Fertilizers Co. Ltd.	Bodosakis Group	Mines at Chalkidiki	90
Lead metal	(GEMEE) Cie. Française des Mines du Laurium.	Peñarroya 66.5%	Smelter at Laurium	50
Lignite	Public Power Corp	Government	Mines and power stations at Ptolemais, Megalópolis, Aliveri.	98
Magnesite	FIMISCO	Scalistiris Group	Mines at Euboea and Chalkidiki; plant at Manthoudi.	70
Nickel	Larco Co	Bodosakis Group	Smelter at Larymna; mines at Euboea and Boeotia.	100
Perlite	Silver and Barite Ores Mining Co.	Eliopoulou-Kyriakopoulou Group.	Mines on Mílos and Kós Island.	80
Petroleum refined	Motor Oil (Hellas) Corinth Refineries S.A.	NA	Refinery at Corinth	34
Steel	Halyvourghiki Inc	NA	Works at Eleusis	50

NA Not available.

Table 1.—Greece: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Aluminum:			
Bauxite, gross weight thousand tons	[r]3,006	2,551	2,984
Alumina, gross weight do	459	450	474
Metal, primary	[r]136,016	133,900	131,715
Antimony, mine output, metal content	[r]215	220	--
Chromium: Chromite, gross weight:			
Ore, crude	[r]73,748	66,849	72,056
Concentrates	[r]24,528	26,908	33,450
Copper, mine output, metal content	1,391	980	1,005
Iron and steel:			
Metal ore and concentrate, nickeliferous, gross weight[2] thousand tons	[r]1,977	2,205	2,050
Pig iron and ferroalloys do	540	400	440
Steel, crude do	[r]721	[e]800	450
Semimanufactures[3] do	905	NA	NA
Lead:			
Mine output, metal content	12,884	29,752	11,625
Metal, refined:[4]			
Primary	[r]16,261	18,692	14,527
Secondary	[r]4,093	NA	NA
Manganese, gross weight:			
Ore, crude	[r]52,782	58,248	45,287
Concentrate	[r]8,294	8,233	7,830
Nickel, metal content:			
Mine output, nickeliferous iron ore[5]	[r]28,178	27,561	25,622
Alloys	[r]14,862	16,448	9,600
Silver, smelter and refined thousand troy ounces	[r]480	477	[e]374
Tin metal, primary	40	[e]40	[e]40
Zinc:			
Mine output, metal content	[r]13,920	26,473	12,696
Metal, including secondary	2	[r e]10	[e]10

See footnotes at end of table.

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Table 1.—Greece: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]		1975	1976	1977[p]
NONMETALS				
Abrasives, natural: Emery		7,000	6,500	6,500
Asbestos		40	[e]2,000	[e]35
Barite:				
Ore, crude		[r]174,596	90,620	95,794
Concentrate		[r]86,760	43,586	38,579
Cement, hydraulic	thousand tons	[r]7,942	8,745	10,584
Clays:				
Bentonite:				
Crude		[r]431,970	316,769	419,449
Processed		[r]251,503	290,450	336,787
Kaolin:				
Crude		[r]72,960	76,725	65,396
Processed		16,881	9,865	9,000
Fertilizer materials:				
Manufactured, gross weight:				
Nitrogenous	thousand tons	283	NA	NA
Phosphatic	do.	187	NA	NA
Potassic	do.	23	NA	NA
Other including mixed	do.	903	NA	NA
Ammonia, anhydrous	do.	287	[e]280	275
Gypsum and anhydrite		416,557	444,686	410,000
Magnesite:				
Crude	thousand tons	[r]1,453	1,284	1,040
Deadburned		359,963	341,484	350,795
Caustic-calcined		[r]57,085	57,456	77,047
Perlite:				
Crude		[r]161,718	228,081	374,245
Screened		[r]113,855	126,732	148,125
Pozzolan (Santorin earth)	thousand tons	[r]851	981	1,256
Pumice		525,952	399,745	568,292
Pyrite, gross weight		188,257	180,368	128,556
Salt, all types	thousand tons	[e]150	140	190
Silica (probably silica sand)		[r]16,765	16,866	25,448
Sodium compounds: Sodium sulfate		6,833	5,435	6,322
Stone: Marble	cubic meters	[r]120,000	170,000	NA
Sulfur, content of pyrite		84,716	81,166	57,850
Talc and steatite		[r]5,867	5,543	NA
MINERAL FUELS AND RELATED MATERIALS				
Coal: Lignite	thousand tons	[r]18,123	22,303	23,572
Coke:				
Coke oven	do.	421	337	300
Gashouse	do.	11	12	15
Lignite briquets	do.	[r]88	50	90
Gas, manufactured:				
Gasworks	million cubic feet	274	274	NA
Blast furnace	do.	42,308	35,308	NA
Coke oven	do.	6,639	6,353	NA
Petroleum refinery products:				
Gasoline	thousand 42-gallon barrels	7,149	8,424	8,458
Kerosine	do.	372	395	326
Jet fuel	do.	5,152	4,728	5,404
Distillate fuel oil	do.	21,932	19,918	20,642
Residual fuel oil	do.	36,150	35,112	33,087
Lubricants	do.	427	385	467
Other	do.	10,164	8,523	7,361
Refinery fuel and losses	do.	5,062	4,248	3,668
Total	do.	86,408	81,733	79,413

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, other types of crude construction materials such as clays, sand and gravel, and stone are also produced, but output is not reported, and available information is inadequate for formulation of reliable estimates of output levels. Cobalt is also produced, but output is included with nickel.

[2]Nickel content is reported under "Nickel metal content."

[3]Black sheet, galvanized sheet, reinforcing bars, and wire only.

[4]Includes antimonial lead and hard lead.

[5]Nickel plus contained cobalt.

[6]Silver content of lead bullion.

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TRADE

Greece had a negative trade balance in minerals during 1977, largely owing to imports of fuels, which accounted for about one-third of the country's mineral imports. Tables 2 and 3 show trade statistics for selected commodities. The United States had an active trade balance in minerals with Greece. U.S. exports of minerals to Greece were valued at about $55.4 million, and coal and iron and steel products were the major items. U.S. imports of minerals from Greece were valued at about $27.2 million, and major items were residual fuel oils and clays. Table 4 shows details.

Table 2.—Greece: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Bauxite and concentrate ____ thousand tons__	1,595	1,367	Romania 493; U.S.S.R. 399; Netherlands 152.
Oxide and hydroxide _____	NA	194,732	Netherlands 191,392; Romania 3,340.
Metal including alloys:			
Unwrought, including scrap _____	89,072	88,970	Italy 39,851; France 36,363; Japan 6,978.
Semimanufactures _____	9,174	17,888	Saudi Arabia 2,947; Syria 2,775; West Germany 2,503.
Chromium: Chromite _____	19,274	21,957	Norway 12,000; West Germany 6,800; United States 2,575.
Copper:			
Matte _____	NA	147	All to Belgium-Luxembourg.
Metal including alloys:			
Scrap _____	NA	781	Belgium-Luxembourg 546; Italy 200; United Kingdom 35.
Unwrought _____	47	--	
Semimanufactures _____	2,414	3,809	France 821; West Germany 722; Italy 683.
Iron and steel:			
Roasted pyrite _____	19,804	18,575	West Germany 18,565; Kenya 10.
Metal:			
Scrap _____	NA	1,024	Italy 330; Netherlands 292; West Germany 236.
Ferroalloys: Ferronickel _____	[1]49,535	57,035	West Germany 19,958; Sweden 11,191.
Steel, primary forms _____	93,446	117,654	Italy 68,558; West Germany 15,853.
Semimanufactures:			
Bars, rods, angles, shapes, sections____	58,227	64,699	Cyprus 14,028; Albania 10,000; Belgium-Luxembourg 10,000.
Universals, plates, sheets _____	107,670	119,171	Yugoslavia 40,081; Syria 23,720; West Germany 17,790.
Hoop and strip _____	3,678	664	Syria 250; Yugoslavia 165; West Germany 155.
Rails and accessories _____	--	13	NA.
Wire _____	1,315	986	Libya 304; Albania 71; Bulgaria 49.
Tubes, pipes, fittings _____	69,561	51,728	Libya 14,311; Nigeria 13,764; Cyprus 10,223.
Castings and forgings, rough _____	NA	761	NA.
Lead:			
Ore and concentrates _____	12,988	37,708	Canada 10,500; Belgium-Luxembourg 10,000; Italy 9,000.
Metal including alloys, all forms _____	1,076	70	France 57.
Manganese ore and concentrate _____	2,966	1,515	West Germany 1,050; Yugoslavia 520.
Zinc ore and concentrate _____	26,110	50,462	Italy 25,908; France 9,000; United Kingdom 7,000.
Other:			
Ores and concentrates _____	6,350	8,500	France 3,000; United Kingdom 3,000; Italy 1,500.
Ash and residue containing nonferrous metals __	26,280	22,856	Netherlands 14,751; Malta 3,203.
Waste and sweepings of precious metals _____	NA	5	NA.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc _____	NA	164,230	United Kingdom 112,584; France 24,895; United States 23,398.
Grinding and polishing wheels and stones_____	--	57	Switzerland 18; Turkey 10; France 6.
Barite and witherite _____	([2])	33,695	Kuwait 10,298; Nigeria 7,000; Libya 5,495.
Cement _____ thousand tons__	2,831	3,907	Libya 1,426; Saudi Arabia 1,307; Algeria 446.
Clays and clay products (including all refractory brick):			
Crude _____	NA	398,553	Canada 159,855; Sweden 3,512; France 3,007.

See footnotes at end of table.

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Table 2.—Greece: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Clays and clay products (including all refractory brick) —Continued			
Products:			
Refractory (including nonclay brick)	25,058	21,550	Romania 4,985; Sweden 3,512; France 3,007.
Nonrefractory	15,998	11,930	U.S.S.R. 3,270; Saudi Arabia 2,357; Syria 1,868.
Fertilizer materials, manufactured:			
Nitrogenous	18,458	20,438	Turkey 10,000; Cyprus 6,223; Belgium-Luxembourg 4,215.
Phosphatic	5,250	--	
Other, including mixed	4,994	10,935	All to Cyprus.
Gypsum and plasters	NA	6,193	United Arab Emirates 3,600; Libya 2,353.
Lime	33,269	36,982	Libya 24,949; Saudi Arabia 8,183; Kuwait 3,330.
Magnesite	NA	355,531	West Germany 128,185; Netherlands 50,049; Italy 39,327.
Mica, crude, including splittings and waste	NA	1,600	All to Libya.
Precious and semiprecious stones, natural, except diamond, value, thousands	--	$132	France $91; West Germany $39.
Sodium and potassium compounds: Caustic soda	NA	102	NA.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked, calcareous	NA	36,079	Italy 11,938; West Germany 7,147; Yugoslavia 6,541.
Worked	51,783	62,891	Libya 30,640; Kuwait 9,555; Saudi Arabia 8,494.
Gravel and crushed rock, n.e.s	NA	15,124	Kuwait 5,750; United Arab Emirates 4,600; Libya 4,000.
Quartz and quartzite	NA	8,746	All to Sweden.
Sulfur:			
Elemental, other than colloidal	10,021	9,523	Turkey 5,400; Morocco 1,982; Cyprus 1,500.
Sulfuric acid	9,188	72,053	Turkey 53,679; Romania 12,017; Albania 3,889.
Other:			
Crude	[2]253,208	187,506	West Germany 68,757; France 39,991; United Kingdom 32,781.
Slag, dross, and similar waste, not metal bearing	7,999	9,030	Norway 7,203; Israel 700; Belgium-Luxembourg 595.
Building materials of asphalt, asbestos and fiber cement, and unfired nonmetals, n.e.s	54,915	40,079	Iraq 12,897; Libya 7,038; Iran 5,384.
MINERAL FUELS AND RELATED MATERIALS			
Coke and semicoke	27,216	36,742	West Germany 21,153; Spain 15,573.
Petroleum:			
Crude and partly refined, thousand 42-gallon barrels	--	233	All to Egypt.
Refinery products:			
Gasoline, motor, do.	6,070	411	United Kingdom 391; Netherlands 20.
Kerosine and jet fuel, do.	2,882	2,780	United States 841; Switzerland 203; France 159.
Distillate fuel oil, do.	4,872	2,443	Tunisia 374; West Germany 298; Italy 212.
Residual fuel oil, do.	6,379	6,064	Italy 3,642; United States 1,194; Sweden 246.
Lubricants, do.	179	76	Syria 15; Cyprus 13; United Kingdom 8.
Other:			
Liquefied petroleum gas, do.	254	59	Tunisia 43; Lebanon 14.
Mineral jelly and wax, do.	--	1	
Petroleum coke, do.	--	18	Mainly to Syria.
Unspecified, including bituminous mixtures, do.	--	50	Tunisia 10; Romania 8; Italy 7.

NA Not available.
[1]Includes pig iron and other ferroalloys, if any.
[2]Barite and witherite are included in "Other, crude."

Table 3.—Greece: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum:		
Bauxite and concentrate	976	4,183
Metal, including alloys:		
Scrap	398	386

See footnotes at end of table.

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Table 3.—Greece: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS —Continued		
Aluminum —Continued		
Metal, including alloys —Continued		
Unwrought	891	3,646
Semimanufactures	1,800	2,389
Chromium:		
Chromite	1,146	5
Oxide and hydroxide	NA	147
Copper:		
Copper sulfate	NA	1,040
Metal, including alloys:		
Scrap	310	17
Unwrought	24,710	23,988
Semimanufactures	1,579	2,119
Iron and steel:		
Ore and concentrate thousand tons	787	370
Metal:		
Scrap	98,167	90,700
Pig iron, including cast iron	15,431	14,599
Sponge iron, powder and shot	515	527
Ferroalloys	5,786	8,058
Steel, primary forms	277,273	255,849
Semimanufactures:		
Bars, rods, angles, shapes, sections	155,649	170,870
Universals, plates, sheets	159,617	172,594
Hoop and strip	42,689	86,077
Rails and accessories	8,257	2,031
Wire	10,040	13,864
Tubes, pipes, fittings	16,547	22,823
Castings and forgings, rough	1,878	1,667
Lead:		
Ore and concentrate	7,614	19,294
Metal including alloys, unwrought and semimanufactures	8,554	10,223
Magnesium metal including alloys, unwrought	NA	477
Manganese:		
Oxide	--	205
Ore and concentrates	2,437	11,081
Nickel metal including alloys:		
Unwrought	39	70
Semimanufactures	378	373
Platinum-group silver and metals, including alloys:		
Platinum-group value, thousands	$171	$417
Silver thousand troy ounces	(1)	95
Tin metal including alloys, unwrought and semimanufactures	595	344
Titanium oxide	NA	7,009
Zinc:		
Oxide	NA	605
Metal including alloys:		
Unwrought	11,695	12,964
Semimanufactures	116	170
Other:		
Ore and concentrates	1,256	752
Ash and residue containing nonferrous metals	1,125	752
Oxides, hydroxides, peroxides of metals	NA	63
Metals including alloys, all forms:		
Metalloids	NA	380
Alkali, alkaline-earth, rare-earth metals	NA	3,864
Base metals including alloys, all forms, n.e.s	33	58
NONMETALS		
Abrasives, natural, n.e.s.:		
Dust and powder of precious and semiprecious stones value, thousands	NA	$1,988
Grinding and polishing wheels and stones	587	208
Asbestos	13,315	20,420
Boron materials:		
Crude natural borates	NA	597
Oxide and acid	NA	78
Cement	938	498
Chalk	NA	2,741
Clays and clay products (including all refractory brick):		
Crude clays, n.e.s	NA	90,726
Products:		
Refractory (including nonclay brick)	28,053	22,728
Nonrefractory	5,043	6,873
Diatomite and other infusorial earth	NA	387
Feldspar and fluorspar	NA	12,034
Fertilizer materials:		
Crude:		
Phosphatic	454,638	346,544
Other	511	--
Manufactured:		
Nitrogenous	52,399	9,554
Potassic	28,150	51,306
Other, including mixed	671	1,175

See footnotes at end of table.

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Table 3.—Greece: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS —Continued			
Fertilizer materials —Continued			
Ammonia		NA	51,362
Gypsum and plasters		NA	885
Magnesite		NA	374
Pigments, mineral: Processed iron oxides		NA	1,559
Precious and semiprecious stones, natural, except diamond	kilograms	(2)	2,000
Pyrite, gross weight		154,015	106,585
Sodium and potassium compounds: Caustic soda		NA	41,573
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked		NA	2,003
Worked		392	150
Dolomite, chiefly refractory grade		NA	271
Gravel and crushed rock, n.e.s		NA	3,312
Sand, excluding metal bearing		NA	84,869
Sulfur, elemental, other than colloidal		83,741	161,781
Talc, steatite, soapstone, pyrophyllite		NA	1,648
Other:			
Crude		NA	577
Oxides and hydroxides of magnesium, strontium, barium		NA	191
Building materials of asphalt, asbestos and fiber cement, and unfired nonmetals, n.e.s		929	742
MINERAL FUELS AND RELATED MATERIALS			
Carbon black		NA	4,553
Coal and briquets:			
Anthracite and bituminous coal		708,908	571,474
Coal briquets		22,190	193
Coke and semicoke		31,258	33,315
Peat, including peat briquets and litter		NA	1,203
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	94,113	86,245
Refinery products:			
Gasoline (including natural)	do.	63	441
Kerosine and jet fuel	do.	972	1,972
Distillate fuel oil	do.	1,622	2,442
Residual fuel oil	do.	1,427	4,660
Lubricants	do.	488	408
Other:			
Liquefied petroleum gas	do.	361	291
Mineral jelly and wax	do.	10	9
Pitch and pitch coke	do.	NA	475
Bitumen and other residues	do.	NA	305
Bituminous mixtures, n.e.s	do.	NA	3
Unspecified	do.	NA	9
Total	do.	NA	11,015
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		8,106	4,496

NA Not available.
[1]Value only given at $11,815,000.
[2]Value only given at $183,000.

Table 4.—Greece: Mineral trade with the United States, 1976[1]

Commodity	Exports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
METALS				
Aluminum metal including alloys	275	$289	384	$647
Copper metal including alloys	611	936	6	23
Iron and steel metal:				
Scrap	23	1	200,923	17,254
Ferroalloys	2,408	2,935	--	--
Semimanufactures:				
Bars and angles	--	--	58	113
Plates and sheets	--	--	1,388	722
Hoop and strip	--	--	35,836	8,002
Rails	--	--	13	27
Wire	--	--	83	130
Tubes and pipes	--	--	379	277
Castings and forgings	3	6	475	234
Lead metal including alloys	--	--	2	4

See footnotes at end of table.

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Table 4.—Greece: Mineral trade with the United States, 1976[1] —Continued

Commodity	Exports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
METALS —Continued				
Nickel metal including alloys	--	--	1	13
Radioactive and associated materials	--	--	1	19
Silver and platinum ores	NA	2	--	--
Tin ore and concentrate	--	--	4	42
Zinc metal including alloys	--	--	10	14
Other nonferrous metals:				
Base metals including alloys	(2)	1	87	185
Scrap	3	2	559	397
NONMETALS				
Abrasives natural, including diamond	23,401	63	447	775
Clays and refractory materials	30,023	5,638	--	--
Diamond and precious stones:				
Industrial	NA	77	--	--
Gem, diamond and precious stones	NA	2	1	15
Stone, sand and gravel:				
Dimension stone	246	99	--	--
Gravel and crushed rock	--	--	61	12
Sulfur and unroasted pyrites	--	--	23,288	1,341
MINERAL FUELS AND RELATED MATERIALS				
Coal, all types	--	--	421,660	16,619
Petroleum refinery products:				
Residual fuel oil	231,155	16,813	--	--
Lubricants	--	--	1,038	892
Petroleum coke, asphalt, etc	--	--	72,173	7,695
Total	XX	27,249	XX	55,452

NA Not available. XX Not applicable.
[1]Data may differ from that given elsewhere in this chapter owing to a difference in source.
[2]Less than 1/2 unit.

Source: U.S. Department of Commerce, Bureau of Census.

COMMODITY REVIEW

METALS

Aluminum.—Greece remained an important producer and exporter of bauxite and was more than self-sufficient in output of alumina and aluminum.

Bauxite.—Bauxite Parnasse Mining Co. S.A. (BPM), owned by the Eliopoulou-Kyriacopoulou Group, remained the leading bauxite producer and exporter in Greece. At its Parnassos-Ghiona mines in central Greece, work continued on expanding capacity from 2 to 3.5 million tons per year. The program included increasing capacity of underground mines from about 500,000 tons to 1.5 million tons per year by 1982.

Eleusis Bauxite Mines (Scalistiris Group), second largest producer of bauxite in Greece, with mines in Eleusis, Lamia, Itea, and Kyria, continued building two 250,000-ton-per-year heavy-media separation installations for processing high-lime bauxite and tailings at Eleusis and Lamia. Completion has been scheduled for 1978. During 1977, Eleusis Bauxite Mines produced about 720,000 tons of bauxite.

Elikon-Bauxite-G. Barlos S.A. (Elikon) was expanding its capacity for bauxite production to 400,000 tons by 1978. During 1977, Elikon produced about 280,000 tons. During 1977, Nucleonic Hellas conducted exploration for bauxite near Vronteron and Florina, northern Greece. Preliminary results indicated existence of an important deposit of alumina in the form of gibbsite.

Alumina and Aluminum.—During 1977, Aluminium de Grèce (AG), partly owned by Pechiney of France and the only alumina and aluminum producer in Greece, was preparing plans for capacity expansion of its alumina plant at Distomon, Boeotia, by 100,000 tons per year to 600,000 tons. Plans indicated a total investment of about $100 million, including about $40 million for foreign-made equipment. The entire additional alumina output will be exported.

BPM continued efforts to find foreign

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partners for investment in a new 600,000-ton-per-year alumina plant at Itea on the Corinthian Gulf. This investment was approved by the Greek Government in 1976, and HIMIC is the cosponsor of the project. Chemokomplex and Aluterv of Hungary, which will provide "know-how" for the plant, revised their figures on investment and production costs during 1977. Based on the new figures further discussions with possible foreign partners were scheduled for 1978. Foreign participation cannot exceed 49%.

Chromite.—The Greek Government, through IGME and GEMEE, continued efforts to determine chromite reserves (previously estimated at 2 million tons) at Vourinos Mountain near Kozáni. At Skoumtsa mine, GEMEE was modernizing outdated mining equipment and beneficiation facilities. After completion of the program, capacity for production of 50% to 52% Cr_2O_3 chromite concentrate should increase from 15,000 tons per year to 60,000 tons per year.

The Government was, in addition, examining the feasibility of establishing a ferrochrome industry in Greece. The Finnish firm Outokumpu Oy completed a feasibility study, but at yearend no decision had been made.

Iron and Steel.—After several months of trial operation, a new 260,000-ton-per-year steel miniplant started normal production. The plant is located in the Almiros area near Vólos.

The only integrated steel producer in the country remained Halivourgiki Inc., with a plant near Eleusis, based on imported iron ore and coke which accounted for about 60% of the country's steel production. Shipbuilding remained the principal consumer of domestic and imported steel and steel products.

Lead, Zinc, Pyrite, Copper.—Production of complex sulfide ores containing lead, zinc, copper, and pyrite was down 30% when compared with output in 1976 because of a strike and closure of the mines.

During 1977, a 7-month-long miners' strike closed the Kassandra mines; the beneficiation plant at Stratoni; and Olimpias mines and beneficiation facilities operated by the Hellenic Chemical Products & Fertilizers Co. Ltd. (HCPF), Bodossakis Group. HCPF was also closing its Hermoni copper-iron-pyrite mine, southeast of the city of Nafplion, Peloponnesus, because of economics and pollution problems. To compensate for the impact of closing the Hermoni mine, the company started developing marble reserves in the area.

After 100 years of operation, the Cie. Francaise des Mines du Laurium closed down its mines at Laurium. Low lead content of ores and low lead prices on the international market made operation at Laurium uneconomic.

Nickel.—Larco Co. S.A. (Bodossakis Group) continued expansion of its facilities at Euboea and Boeotia from the present 15,000 tons to 27,000 tons of nickel, reportedly to be completed during 1978. During 1977, construction began on a 10-kilometer conveyor belt from the opencast mines to the crushing facilities at Politika in northwest Euboea. About 80% of the equipment needed for expansion was delivered, including a rotary kiln from Krupp, Federal Republic of Germany, and two electrofurnaces and other equipment from France. Because of technological improvements and escalating pollution control costs, the Greek Government has approved Larco's request to increase the original investment of $50 million to $68 million.

Eleusis Bauxite Mines was awaiting Government approval to invest $60 million to $65 million in a new 10,000-ton-per-year nickel plant on Euboea; consequently all major work remained at a standstill through the year. The project also includes development of a 70-million-ton deposit of lateritic ore, with an aggregated average metal content of nickel and cobalt of 1%, located at Pashna, Euboea. Bechtel Corp. of the United States was to provide engineering and construction management. Elkem-Spigerverket A/S of Norway was to act as consultant.

NONMETALS

Asbestos.—The Greek Government has decided to go it alone on development, through ETVA, of the Zidanion mines near Kozáni. ETVA organized a company named Asbestos Mines of Northern Greece. Mining Sociètè Anonyme (AMNG) and the new company started operation at Zindanion mines at Kozáni. As a result of activities during 1977, asbestos reserves at Zidanion were revised upward to 90 million tons.

In November 1977, AMNG applied to the authorities for approval of a $68 million investment to build, by 1980, a 100,000-ton-per-year asbestos fiber plant at the Zidanion asbestos mine near Kozáni; the plant would employ 300 persons, and about 75% of its fiber output would be exported. U.S.

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standards of pollution control will be applied. Killburn Engineering Ltd. of Toronto, Canada, was appointed technical advisor for the project.

Barite.—Mykobar Mining Co. S.A., the major barite producer in Greece, a subsidiary of Dresser Industries of the United States, was examining possibilities for bringing into production additional barite reserves on Mykonos Island. During recent exploration activities, geologists from Mykobar proved existence of a new 400,000-ton barite deposit on Mykonos. Preliminary results of exploration near the shore of the island indicated an additional 1.2 million tons of barite under the sea.

Nearly all of the barite produced in the country was exported to the United States and other oil producing countries.

Bentonite.—The Silver and Baryte Ores Mining Co., a major producer of bentonite and other industrial minerals in Greece, started construction of a 350,000-ton-per-year bentonite processing installation on Milos. During 1977, the company completed about 50% of the project, including a drying plant. Plans called for completion of the project by 1979.

Cement.—During 1977, the Titan Cement Co. S.A. (Titan) obtained Government approval to spend about $44 million for construction of a 1-million-ton-per-year cement plant at Kamari, Boeotia. Titan expects to complete this project by 1981. In addition, modernization of the Aspropyrgos plant in Attica, operated by Halyps Cement Co. S.A., continued during 1977. A French-German-made rotary kiln and associated equipment will replace three obsolete cement kilns, and the Aspropyrgos plant capacity should increase from 450,000 tons of cement per year to 600,000 tons per year by 1979. The management of Halyps estimated an expenditure of about $1.6 million for pollution control equipment for the Aspropyrgos plant.

During 1977, the cement industry in Greece produced almost at full capacity of 11.7 million tons per year. Four companies operated eight plants; Heracles General Cement Co. S.A. and Titan were the largest operators, accounting for 36% and 35%, respectively, of installed cement capacity in Greece. The largest cement plant in Greece was Olympos at Volos, with a capacity of 3 million tons per year, operated by Heracles General Cement Co. S.A. About 53% of total cement output in Greece was sold on the domestic market.

Magnesite.—During 1977, the magnesite industry of Greece was hit hard by the steel recession in Europe, and uncertainties about the future of the national economies of Western Europe resulted in delaying planned expansion in the magnesite industry.

Financial Mining-Industrial and Shipping Corp. (FIMISCO), the largest producer of magnesite, temporarily halted development of a $50 million plant for producing refractory magnesia from seawater and dolomite. In addition, the company canceled plans to develop magnesite mines on Levbos Island.

Macedonian Magnesite Mining Industrial and Shipping Corp. postponed implementation of a plan to build a plant for production of briquetted dead-burned magnesite at the firm's mining site at Ormelia, Chalkidiki.

Although Grecian Magnesits Ltd. S.A. purchased some mining equipment for its open pit mines at Gerakini, Chalkidiki, it postponed purchase and installation of a third 160 to 180-ton-per-day-capacity rotary kiln for its sintering facilities. Magnomine General Mining Co. S.A., a subsidiary of General Refractories (United States), delayed purchase of a new 250-ton-per-day shaft kiln for its magnesite-processing installations at Chalkidiki.

Marble.—GEMEE started marble production from a quarry at Verria in northern Greece, and plans were underway to start another quarry in the Attica region. Planned aggregated annual output of both quarries was set at 8,500 cubic meters of marble.

The Hellenic Chemical Products and Fertilizers Co. started development of marble production at Hermoni, near Nafplion, Peloponnesus. The size of the operation was not made public.

Quartzite.—Forty kilometers northeast of Thessaloniki, Hellenic Industrial Minerals S.A. (Elvior) started production from a new quartzite quarry. Reportedly the quartzite is of 99% purity and is suitable for production of metallic silicon. Reserves were not reported. Planning for expansion of the mine and construction of a mill was underway at yearend. The product will be exported to countries in Western Europe.

MINERAL FUELS

Imported petroleum remained the principal source of energy in Greece. During 1976, the last year for which complete data were available, about 83% of Greece's apparent fuel and power consumption was met

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through imports. Petroleum and refinery products accounted for approximately 97% of primary energy imports. Lignite was the principal source of energy produced in the country and provided 26% of apparent energy consumption. However, additional imports of high-rank coals were necessary to meet demand. Table 5 shows supply and apparent consumption of fuel and power for 1975 and 1976 in million tons of standard coal equivalent (SCE).

Table 5.—Greece: Supply and apparent consumption of fuels and power

(Million tons of standard coal equivalent)[1]

	Total primary energy	Coal and coke	Petroleum and refinery products	Fuelwood	Hydro-electric power
1975:					
Production	6.2	5.9	--	(2)	0.3
Imports	22.6	.6	22.0	(2)	(2)
Exports	4.8	(2)	4.8	(2)	(2)
Apparent consumption	24.0	6.5	17.2	(2)	.3
1976:					
Production	6.7	6.4	--	(2)	.3
Imports	20.2	7.1	17.0	(2)	.3
Exports	2.5	(2)	2.5	(2)	.3
Apparent consumption	24.4	7.1	17.0	(2)	.3

[1]1 ton of standard coal equivalent (SCE)=7 million kilocalories (per DOE).
[2]Less than 1/2 unit.

Source: Adapted from United Nations, World Energy Supplies (1950-1974), Statistical Papers, Series J, No. 20, 1977, 239 pp.

Coal.—Lignite was the only mineral fuel produced in significant commercial quantities in Greece during 1977. High prices for imported energy made domestic low-grade lignite, neglected in the past, an important source of energy. IGME conducted exploration for lignite, mostly in northwest Greece, with funds supplied by the Government-owned PPC, the major lignite mine operator in the country. PPC also was involved in expanding operational lignite mines.

Out of total production of 23.2 million tons of lignite, 16.1 million tons were produced from the Ptolemais mines, 6.7 million tons were mined at the Megalópolis lignite field, and the rest came from mines at Aliveri, Euboea. Most of the lignite produced was used for production of electric power. Lignite-fired powerplants accounted for about 60% of the total electric energy produced in the country.

The search for lignite was intensified during 1977. Exploration drilling totaled 15,799 meters. Exploration was concentrated in the areas of Amynteon, Valtonora near Amynteon, Xyrolimni near Kozáni, Elos in Edhessa, and Perdika Komninan. Preliminary results indicated a 200-million-ton lignite deposit. Amynteon was the site of the most intensive exploration. During 1977, as a result of exploration, measured reserves at Amynteon were increased from 140 million tons to 225 million tons. Plans were announced to develop a mine, and a preliminary engineering study should be completed by the end of 1978. Lignite from Amynteon was planned for use in each of two 300-megawatt units, scheduled to start production in 1985 or 1986.

Most mine expansion activities were conducted by PPC in the lignite fields of northern Greece. At the Ptolemais mines, operated by PPC, measured lignite reserves were increased from 1.4 billion tons to 2.1 billion tons as a result of additional exploration. In the same area, the development of Ptolemais' untapped South field was stepped up during 1977. A Federal Republic of Germany firm, Otto Gold GmbH, completed an engineering study for PPC to develop South field to supply seven additional 300-megawatt-power units at Kardia. In November 1977, PPC signed a contract with a Greek firm, Metal Construction of Greece S.A. (METKA), for construction and installation by 1980 of a 12-kilometer conveyor belt for moving overburden in the South field. A second conveyor belt system was planned to move lignite. Planned production in the South field was between 16 and 18 million tons per year in 1980 and between 40 and 42 million tons per year by 1990.

At the PPC-operated Megalopolis mine, Greece's second largest lignite producer,

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preparation continued to increase output to 14 million tons by 1990. During 1977, the Federal Republic of Germany's consultant, Hanz Goergen, completed an engineering study for development of the Kilparissiom and South Horemi fields at Megalópolis. Tenders for purchasing mining equipment (five bucket wheel excavators, two stackers, one walking-type dragline, etc.) were to be issued during 1978.

The Aliveri lignite deposits are approaching exhaustion, and PPC intends to close the mines between 1980-82. In addition to domestic lignite, Greece imported high-rank coals and coke to meet its industrial demand. Tables 2, 3, and 4 show foreign trade of Greece in coal and coke.

Petroleum and Natural Gas.—During 1977, Greece remained without domestic crude oil and natural gas production, and all the country's demand was met through imports. However, preparation for development of a recently discovered offshore deposit and offshore and onshore exploration for crude oil and natural gas were underway.

Exploration.—Most of the offshore exploration was carried out near the island of Thássos and most of the onshore exploration was in the nearby delta of the Nestos River in northern Greece. Exploration activities offshore consisted of geophysical work and drilling in the area called South Thássos. The North Aegean Petroleum Corp. operators for Denison Consortium, made arrangements for the drilling ship, *Wodeco,* to drill three exploratory wells in the Thássos area during 1978. Under the contract between the Government and Denison, exploration in the Thássos area was to be completed within the 1978-79 period.

DEP specialists, together with consultants from the French Institut Français du Pétrole, evaluated results of drilling the Nestos I and Nestos II wells in the Nestos Delta, which were completed by contractors from Romania. To determine the site of the Nestos III well, additional seismic work was done by Rogers Exploration Co. of Houston. By yearend, Romanian contractors for Nestos III had completed drilling to a final depth of 3,500 meters. In addition, a well in the Komotini area was completed at 2,500 meters. Results of these two drillings were not made public at yearend.

Furthermore, as a result of contracts signed by DEP, the U.S. firm Geophysical Service, Inc., and the French firm Cie. General de Geophysique, exploration commenced in the areas of the Ionian Sea; Préveza; and the Corinthiakos, Patriakos and Kyparissiakos Gulfs. In addition, DEP completed a survey of the Xanthi-Komotini area in western Thrace and DEP was also conducting exploration in the Philippoi Plain, near Kaválla, and stratigraphic surveying in the Strymon River valley, Serres area.

Production.—During 1977, preparations were underway to start development of the Thassos oilfield, the first oilfield in Greece, for a target output of 25,000 barrels of oil per day. Some problems related to location of the production platform must be resolved before actual work can start.

Refining.—During 1977, four petroleum refineries, with annual capacity of 20 million tons, were in operation in Greece. The largest refinery was Motor Oil (Hellas) Corinth Refineries, Corinth, with an annual capacity of 7 million tons of crude oil.

Uranium.—The United Nations Development Program's assistance in training Greek personnel ceased in September 1977. Scientists from Democritus Research Center continued exploration for uranium in eastern Macedonia and Thrace. Preliminary results were encouraging.

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[1]A principal source of information for this chapter was: State Department Airgram A-20, Mar. 3, 1978, drafted by D. Kirkini at the U.S. Embassy in Athens.

[2]Physical scientist, Branch of Foreign Data.

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The Mineral Industry of Hungary

By George Rabchevsky[1]

In 1977, Hungary's national income was 474 billion forints (Ft),[2] 46% of which came from industrial operations, 16% from agriculture, 16% from transportation and telecommunications, 8% from commerce, and 14% from water management. According to the 1977 budget, revenues totaled Ft361 billion against total expenditures of Ft365 billion, thus showing a deficit of Ft4 billion. The mining industry contributed Ft10 billion to Hungary's total revenues (Ft361 billion) in 1977, and the metallurgic industry accounted for Ft8 billion of the total, representing 10% and 8% of total heavy industry revenues (Ft104 billion) in 1977, respectively. The contribution of the minerals sector to the overall economy in 1977 is given in percentages in the following tabulation.

Industry	Gross production	Total employment
Mining	3.9	7.0
Metallurgy	9.7	5.9
Iron and steel manufacturing	2.9	3.8

Sources: Statisztikai Evkönyv 1977 (Statistical Yearbook 1977), Budapest, 1978. Statistical Pocket Book of Hungary 1978, Budapest, 1978.

Geologic maps show that, in general, most of the mineral resources of Hungary occur along definite structural zones and are confined to a narrow band of highlands and foothills, extending in an arc-like fashion across the country from southwest to northeast. The natural resources of Hungary are primarily of sedimentary origin and only a few are magmatic. Hungary produces some 70 different mineral commodities. In comparison to its neighboring countries, Czechoslovakia, Austria, Yugoslavia, and Bulgaria, Hungary may be considered in the mid-field in regard to mineral self-sufficiency. Almost 50% of its mineral requirements can be supplied from domestic sources.

Worldwide, Hungary occupies a leading position in bauxite reserves and production, even though mining there began later than in other European countries (about 50 years ago). Hungarian oil exploration began just before World War II. Systematic geologic exploration has led to the discovery of large reserves of bauxite and of less abundant reserves of oil, natural gas, and manganese ore. However, with the exception of bauxite and manganese ore, there are insufficient supplies of metallic ores.

Iron ore deposits are located in the northeastern uplands near Miskolc. Rudabánya, the largest open pit mine, is the principal source of iron ore, with an annual production total of 400,000 tons. Manganese is mined mostly at Urkút and Eplény in the Bakony Mountains, north of Lake Balaton. This oxidized and partly carbonaceous manganese ore occurs in marine Jurassic deposits.

Uranium was discovered in Hungary in 1954 near Pécs in the Mecsek Mountains and there probably are also deposits along the Száva River near the Czechoslovakia frontier. The concentrated uranium ore localities are associated with the weathering of the Paleozoic granites and Paleozoic-early-Mesozoic (Permian) sandstones. Little is known, however, about these apparently rich deposits except that ore from them is exported to the U.S.S.R. for processing.

Most of Hungary's coal deposits are found in the foothills of the main uplands, cross-

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ing the country in a southwest-northeast direction and in the Mecsek Mountains. The largest lignite basin in Hungary is at Borsod, where coal occurs in Upper Tertiary deposits of the Sajó Valley, east of the Danube. West of the Danube, lignite is found in a basin between Tatabánya and Ajka Valleys and at Szombathely. Bituminous coal is mined at the foothills of the Mecsek highlands, near the towns of Pécs and Komló, in the southwestern part of the country. Hungary provides most of its own coal and natural gas requirements and exports bauxite. Most of its raw materials come from the U.S.S.R. and it imports the more advanced types of capital goods and certain raw materials from the West.

Government Policies and Programs.—Hungary enjoyed strong economic growth in 1977. However, this strong domestic performance was marred by a growing trade deficit. Imports in 1977 increased sharply (18%), spurred by above-plan investments and higher prices; exports were 10% lower than imports, owing to unfavorable external conditions, the high level of domestic demand, and the continuing noncompetitiveness of many Hungarian products in world markets. Among the Eastern Europe centrally planned economies, Hungary ranks behind the German Democratic Republic and Czechoslovakia statistically in per capita income. However, under economic reform and other measures introduced officially in 1968, which encouraged enterprise initiative and flexibility, the quality of life and relative availability of consumer goods have improved greatly.

Since Hungary started its first 5-year plan in 1956 (1956-60), it has completed four such plans and is now in its fifth 5-year plan (1976-80). The 1977 plan had posted as a goal a strong improvement in economic efficiency over that of the 1976 year, so as to accelerate growth in the national income and to approach the prescribed expectations of the 5-year plan. The national income increased in 1977 by 10%, exceeding the projected 7% and reaching Ft474 billion. At the same time, the consumer price level, wages, and income also increased much more than planned for 1977. Also, domestic consumption, projected at 4%, increased by 5%.[3]

Capital investments, at Ft201 billion, exceeded the 5-year plan by 10%, resulting in an unbalanced economy. Record high investments in the development of the copper mine at Recsk and the implementation of the Eocene mining program probably contributed significantly to the 1977 budget deficit. Thus, one of the goals of the 1978 plan is to improve production efficiency and the economic balance.

Hungary's foreign trade increased dynamically in 1977 and the 1978 goal is the further expansion of the financial resources for export oriented developments. The value of foreign trade increased by 18% in 1977 to Ft503 billion. A bank office that opened in New York in 1977 is also expected to contribute to the expansion of Hungarian-American economic contacts.[4]

In comparison, industrial production in 1977 increased 7% making up for the 1976 lag in output. However, the external and internal economic balance still deteriorated and was at variance with the 1977 planned target. While exports to centrally planned economy countries increased 19% during 1977, exports to market-economy countries lagged (at 9%) behind the planned targets, and imports from the latter were greater (by 19%) than planned.[5]

The fifth 5-year plan (1976-80) calls for a total investment of Ft870 billion in development of the national economy, about 25% more than in the previous 5-year period. The plan outlines a number of investment priorities. For example, it prescribes that electric power generating facilities be increased 1,500 megawatts; the Danube (Duna) Vasmü steel and coking plant is to be expanded and modernized; the Szekesfehervar Könnyüfemmü (light metal) plant is to be expanded; and refining facilities for olefin production are to be developed. The plan also calls for significant investments to be made in the Borsodi Vegyi chemical complex, the Tiszai Vegyi complex (partly for the production of fertilizers), and the Belapatfalva cement plant. The majority of these projects have been proceeding as planned. Many of them have been finished and some are already in the production stage; however, there are also backlogs. Construction of electric power facilities and the Danube Vasmü coking plant is lagging.

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Also, completion of the Bélapátfalva cement plant and the construction of the Borsod chemical complex (No. 4 nitrogen plant) have been delayed by a year. The 1977 national economic plan envisaged completion of 14 major construction projects, some of which were backlogs. At yearend, production equipment was already in operation in six projects and only the finishing touches were required: The second stage of the Danube oil refinery, the second and third stages of the Danuamenti thermal power station, the cement plant at Hejöcsaba, and the nitrogen and asbestos cement works at Nyergesújfalu. The basic capacities have also been put into operation in the first and second stages of the Hungarian-Soviet gas pipeline. The installation of the telecommunications system of the pipeline was to be left until the beginning of 1978.

At the Almásfüzitö alumina plant, the annual alumina production capacity was increased by 40,000 tons or 5% in 1977, and output at the Nyirád-Deák bauxite mine, by 350,000 tons. The capacity of the Tisza thermal powerplant was expanded by almost 430 megawatts, or 10%. At the Ózd metallurgical works, a new steel production unit was placed into operation.[6]

Special attention is to be focused on the metallurgical sector in the fifth 5-year plan. Renovation of the various ironworks and the development of ferromanganese production are to be made, and maintenance and management of the steelworks are to be improved.[7]

The 1978 plan envisages production of coal to be 25 million tons; petroleum production, 2 million tons; and natural gas extraction, 247 billion cubic feet. Some of Hungary's energy resources are to be imported from the Council for Mutual Economic Assistance (CMEA)[8] countries, primarily from U.S.S.R.

In 1980, the share of petroleum and natural gas in total energy consumption is expected to be 62%; coal is expected to supply 32%; and hydroelectric and imported power, 6%. During the fifth 5-year plan, Hungary is to devote 15% of its total investments to the development of the energy sector.

In 1977, the construction of two new lignite coal mines, with a designed capacity of 4 million tons each, was underway in the Transdanubia region. Despite increased production of domestic energy, the Hungarian economy's dependence on imports continued to grow. A 750-kilovolt electric transmission line between Vinnitsa (U.S.S.R.) and Alberti is to be completed by the end of 1978, and more are to be strung later. Also, nearing completion were the "Szovetség"-Orenburg natural gas pipeline (a CMEA project) and the Adriatic petroleum pipeline (a Hungary-Yugoslavia-Czechoslovakia project). The first stage of the 1,760-megawatt nuclear power station at Paks was under construction and more are being planned. Hungary does not have a totally independent electric power system and receives much of its power from CMEA countries; as a member of a nearly 83,000-megawatt electric energy cooperative, it receives and shares electric energy with Bulgaria, Romania, Czechoslovakia, Poland, the German Democratic Republic, and the west Ukraine of the U.S.S.R.[9]

PRODUCTION

The actual growth rates of industrial production in Hungary during the last three 5-year plans were 7.5% in 1961-65 (second), 6.2% in 1966-70 (third), and 6.4% in 1971-75 (fourth). The planned industrial growth rate during the current 5-year plan (1976-80) is 6% and the change in 1977 was 6.6% over that in 1976.[10] Although Hungary has a poor raw materials base, the leadership has recognized the country's historical strength as an agricultural supplier and has provided capital and encouragement to develop this sector. However, Hungary has a chronic labor shortage, so that economic progress must come almost entirely from increased labor productivity. In the recent past, Western economic uncertainties and deteriorating terms of trade with both the West and the U.S.S.R. (principal supplier of most raw materials) have caused serious difficulties.

The contribution by industry to the Hungarian national income increased from 36.6% in 1960 to 46.3% in 1976 and decreased to 46% in 1977. The anticipated 1978 output is to increase by almost 7%. As part of this planned increase, a new plant at the Borsod chemical complex and the plant at

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the Tizsa chemical combine are to begin production in 1978. More synthetic materials are to be imported from the centrally planned economy countries and the production and purchase of natural gas, oil, iron and steel, and other mineral commodities are to be increased.

Efforts were made to improve industrial production by dropping uneconomic products and continuing to increase specialization. Industries identified for rapid development in the 5-year plan included aluminum, machine tools, food processing equipment, pharmaceuticals, buses, and vehicle parts. The Government also allocated investment funds to increase exploitation of Hungary's modest oil and natural gas resources and to expand coal production, in order to reduce dependence on energy imports.

Production of many metallic minerals remained almost unchanged in 1977. This stabilization was noticed in bauxite, iron ore, lead, and zinc. In contrast, the production of some nonmetallic minerals showed a considerable increase to about 1 million tons (almost four times that of 1967). The volume of limestone production doubled.[11]

The production and sales volume of the metallurgical industry in 1977 exceeded the 1976 level. This expansion of domestic production made it possible to meet the increased obligations to the centrally planned economy countries and to broaden the export product base to the market-economy countries. In 1977, the gross production value of manufactured metals at current prices was Ft65 billion. This amount exceeded the 1976 base by Ft3 billion or 4.5%. The 1976-77 production values for some of the metallurgical products are shown in the following tabulation in billion forints:

	Production values		
	1976	1977	Index (percent)
Ferrous	44.3	45.9	103.6
Aluminum	12.5	13.6	108.8
Nonferrous	5.7	5.8	101.8
Total	62.5	65.3	104.5

Source: Kohászat (Metallurgy), Budapest. V. 3, No. 8, 1978, pp. 366-370.

The 1977 profit of the metallurgical industry was Ft5 billion, which represents a 2% decrease from that of the preceding year (mostly in the ferrous metallurgical industry). The overall 1976-77 sales and production values of the metallurgical industry are shown in the following tabulation in million forints:

	1976	1977	Index (percent)
Production values	62,479	65,300	104.5
Sales values	61,566	65,116	105.8

As can be seen from the tabulation, in 1977 the increase in earnings surpassed that of production. Domestic sales of metal products in 1977 exceeded those for 1976 by 3.6% or Ft1.6 billion. Domestic sales of ferrous products increased 5.8% or Ft1.9 billion, while the demand for aluminum products decreased slightly, and earnings were 0.3% or Ft200 million less.

The mining industry employed 119,000 individuals in 1977, but planned mechanization is expected to reduce this number to 100,000 by 1990, while productivity is to increase 25%. The metallurgical industry employed 100,000 individuals. The 1961-77 statistics for accidents in the mining and metallurgical industries are given in the following tabulation:

Industry	Reported accidents	Fatal accidents	Accidents per 1,000 workers
Mining	8,567	28	87.5
Metallurgical	3,933	10	50.7

Sources: Statisztikai Evkönyv 1977 (Statistical Yearbook 1977), Budapest, 1978. Statistical Pocket Book of Hungary 1978, Budapest, 1978.

In 1977, the Hungarian Central Geological Board undertook a long-term metals exploration program. Hungarian Aluminum Trust (HAT) initiated the opening of several new high-capacity bauxite mines, and Hungary's alumina-producing capacities will be extended substantially. Development of the No. II copper mine at Recsk continued in 1977. Uranium was continued to be mined in the Mecsek Mountains at 1,000 meters below the surface. As in all the previous years, uranium production and utilization was not reported. Production of medium-grade iron ore in 1977, mostly in Rudabánya, totaled 525,000 thousand tons; higher-grade ore was still imported from the U.S.S.R. Manganese (run-of-mine) ore

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production totaled 160,000 tons and the reported production of manganese ore concentrate was 120,000 tons. Lead and zinc ore production increased slightly from that of 1976, with mine ore output reaching 151,000 tons and ore concentrate 8,220 tons.[12]

The 1977 plan envisaged a 3.2% increase in the volume of metallurgical production. Crude steel output was to increase to 3,750,000 tons and rolled steel production was to increase 5%. The actual amount of rolled steel increased 8% from 2,857 million tons in 1976 to 3,077 million tons in 1977. The 1977 plans were almost fulfilled for major metallurgical products. The following tabulation shows the planned and the actual production of some of the metal commodities during 1976-77, in thousand tons.

Commodity	1976	1977		Actual increase (percent)
	Actual	Planned	Actual	
Pig iron	2,221	2,300	2,286	2.9
Crude steel	3,652	3,750	3,723	1.9
Rolled steel	2,857	3,000	3,077	7.7
Hot-rolled steel pipe	184	185	186	1.1
Alumina	732	785	783	7.0
Aluminum ingot	70.5	71.5	71.3	1.1
Aluminum semifinished products	154	135.7	160	3.9

Source: Modification of data given in Kohászat (Metallurgy), Budapest. V. 3, No. 8, 1978, pp. 336-370.

Coal and lignite production in 1977 reached 25,454,000 tons, exceeding only slightly that of the previous year. However, a substantial growth in production is expected from the opening of new mines under the Eocene Program.

A noticeable rise in production of the nonmetallic minerals was achieved in 1977. This was mostly owing to the marked increase in the production of glass sand at the Fehérvárcsurgó plant and perlite at the Pálháza works.

Mining Investment and Exploration.—Hungary's mining investment and development objectives are not as much concerned with the opening of new mines as they are with the eventual processing and production of finished and semifinished products. This especially applies to the manufacture of materials from nonmetallic minerals, primarily dolomite, kaolin, industrial sands, siliceous earth, perlite, and bentonite. The Hungarian mineral industry concentrated on increasing investments in mining aimed at producing more solid fuels in 1977. Coal prospecting in new areas, for example, increased and a program for more efficient exploitation of known mines was initiated in order to raise their capacities through mechanization and improved management. It is estimated that 1,500 million tons of coal may be available as additional reserves, with further exploration needed for their location and extraction. To achieve this, more than 90 kilometers of exploratory drilling is envisaged during the current 5-year plan. Investments were also funneled into oil, gas, copper, and bauxite prospecting and production.

The investment trend of the Hungarian mineral industry since 1965 is shown in the following tabulation:

Industry	Percent			1977 at current prices	
	1966-70	1971-75	1977	Billion forints	Percent of 1976
Industry total	100.0	100.0	100.0	57.7	128.3
Of which:					
Mining	15.1	9.5	9.9	7.6	125.4
Metallurgy	11.1	7.8	7.1	5.3	142.9

Sources: Statisztikai Evkönyv 1977 (Statistical Yearbook 1977), Budapest, 1978. Statistical Pocket Book of Hungary 1978, Budapest, 1978.

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In 1977, Hungary spent approximately Ft2 billion on geological exploration alone, with satisfactory results. This exploration program was directed at the discovery of new mineral deposits and the detailed exploration of the already known mineral deposits. Reserves of newly discovered minerals have grown faster than production. Seventy-three percent of the expenses were for exploration of new oil and gasfields, 24% for coal and bauxite, and 3% for precious metals and nonmetals. The immediate requirements for oil, gas, and bauxite spurred these large investments, while the moderate coal exploration expenditures were owing to the availability of known and relatively abundant reserves.

The Hungarian Aluminum Trust (HAT), especially the Bauxite Exploratory Enterprise, initiated in 1977 a program of improving the management of aluminum production and the exploration and delineation of new ore deposits. The latter, for example, drilled almost 10 kilometers of prospecting holes in 1977.

Development of the copper mine at Recsk proceeded in 1977 at an accelerated pace. The discovery of the porphyry ore at Recsk, and the fact that it occurs within the Drano Line, a major tectonic zone, has sparked a regional exploration and mineral search along this extensive fault structure.

Exploration for rare metals continued as planned. As part of this program, the 6th International Conference on Rare Metals was held in Budapest in 1977. Most of the rare metals exploration was conducted by the Mecsek Ore Mines, under the sponsorship of the International Atomic Energy Agency. Exploration for uranium steadily continued in 1977, under close supervision by the U.S.S.R. As before, all of the uranium ore was sent to the U.S.S.R. for processing.

The Hungarian Oil and Gas Trust (OKGT), which consists of some 27 enterprises, is responsible for exploration, production, processing, and marketing activities of petroleum and natural gas. As a result of its geological exploration, 60% of a planned 10-year program could be accomplished by the beginning of 1978. By the end of the current 5-year plan period, Ft40 billion may be invested by the Trust in order to accomplish the projected exploration and development program. For example, in addition to the 55 areas explored in 1976, exploration of 48 new oil and gas targets began to be explored in 1977 and final surveys were concluded on seven producing areas. The latter included Mihályi (gas), Pusztaapáti (oil), Harta (gas), Csanádapáca (oil and gas), Nagykörü (gas), northern Kiskunhalas (oil and gas), and Pátró (gas). A total of 370,000 meters was drilled for oil and gas in 1977, in comparison to 336,000 meters in 1976. Of these, 272 were of medium depth, 22 were shallow, and 76 were deep wells, 3 of which were classified as "very deep." The average depth of wells in 1977 was 2,199 meters versus 2,228 meters in 1976.

Table 1.—Hungary: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Aluminum, gross weight:			
Bauxite thousand tons	2,890	2,918	2,949
Alumina do	756	732	783
Metal, primary	77,221	70,499	71,335
Copper:			
Mine output, metal content	1,400	1,360	1,010
Smelter:			
Primary	([2])	([2])	--
Secondary	5,500	[r]5,200	3,800
Refined, including secondary	11,200	[r]10,600	11,900
Gold, mine output, metal content[e] troy ounces	160	155	115
Iron and steel:			
Iron ore, gross weight thousand tons	642	602	525
Pig iron:			
For steel industry do	2,142	2,111	2,175
For foundry use do	77	110	111
Total do	2,219	2,221	2,286
Ferroalloys do	7	7	7
Crude steel do	3,673	3,652	3,723
Steel semimanufactures, rolled only do	2,675	2,857	3,077

See footnotes at end of table.

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Table 1.—Hungary: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS —Continued			
Lead:			
Mine output, metal content	900	r900	1,300
Metal, refined, secondary	200	r300	200
Manganese ore:			
Run of mine[3]	182,365	165,074	160,637
Concentrate	131,000	125,000	120,000
Silver, mine output, metal content thousand troy ounces	32	r32	39
Zinc:			
Mine output, metal content	2,200	2,200	2,800
Smelter, secondary	680	655	600
NONMETALS			
Cement, hydraulic thousand tons	3,759	4,298	4,620
Clays:			
Bentonite:			
Raw	87,863	71,148	80,003
Processed	57,920	51,012	51,636
Kaolin:			
Raw	82,153	85,733	71,455
Processed	6,344	6,215	6,000
Fertilizer materials, manufactured:			
Nitrogenous:			
Gross weight thousand tons	2,056	2,402	2,507
Nitrogen content do.	421	492	514
Phosphatic:			
Gross weight do.	1,090	994	871
Phosphorus pentoxide content do.	206	188	165
Ammonia, anhydrous do.	624	855	887
Lime, calcined do.	714	732	743
Perlite	72,040	96,180	103,270
Pyrite, gross weight[e]	7,000	7,000	7,000
Refractory materials, n.e.s.:			
Chamotte products do.	171	169	171
Chrome magnesite products do.	72,040	96,180	103,270
Sand and gravel:			
Gravel thousand cubic meters	11,860	12,625	12,890
Sand, common do.	437	471	288
Sand, foundry thousand tons	710	687	732
Stone:			
Dimension, all types do.	4	4	3
Other:			
Dolomite do.	1,089	1,126	1,173
Limestone do.	7,510	8,038	8,263
Quartzite do.	33	42	34
Sulfur:			
From pyrite[e]	3,000	r3,000	3,000
Byproduct, elemental, all sources	8,937	7,778	8,004
Total	11,327	r10,778	11,004
Sulfuric acid	630,358	617,208	632,632
Talc[e]	16,000	16,000	16,000
MINERAL FUELS AND RELATED MATERIALS			
Carbon black[e]	4,500	4,000	5,000
Coal:			
Bituminous thousand tons	3,020	2,934	2,925
Brown do.	14,963	14,779	14,433
Lignite do.	6,904	7,544	8,096
Total do.	24,887	25,257	25,454
Coke:			
Coke oven:			
Metallurgical do.	593	604	586
Other do.	178	r169	e170
Total do.	771	r773	756
Gashouse do.	229	203	e190
Grand total do.	1,000	976	946
Fuel briquets do.	1,082	1,018	1,105
Gas:			
Manufactured million cubic feet	22,495	22,531	20,376

See footnotes at end of table.

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Table 1.—Hungary: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]		1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS —Continued				
Gas —Continued				
Natural, marketed	million cubic feet	183,000	r214,783	253,464
Natural gas liquids:				
Natural gasoline	thousand 42-gallon barrels	757	1,148	1,420
Liquefied petroleum gas	do	1,299	r1,740	e2,150
Peat (agricultural use)[e]	thousand tons	65	70	70
Petroleum:				
Crude:				
As reported	do	2,006	2,142	2,191
Converted	thousand 42-gallon barrels	15,306	16,343	16,717
Refinery products:[4]				
Gasoline, including naphtha	do	r9,784	r10,038	9,928
Kerosine and other light distillates[5]	do	r5,797	r7,626	6,107
Distillate fuel oil	do	25,938	r25,707	25,685
Residual fuel oil	do	22,870	r23,370	23,543
Lubricants	do	r1,254	r1,317	1,228
Other:				
Liquefied petroleum gas	do	r1,059	r1,067	e1,100
Asphalt and bitumen	do	3,691	r3,600	4,006
Paraffin and petrolatum	do	170	200	198
Total	do	r70,563	r72,925	71,795

eEstimated. pPreliminary. rRevised.

[1]In addition to the commodities listed, diatomite, gypsum, and other crude construction materials such as common clay are produced, but available information is inadequate to make reliable estimates of output levels.

[2]Revised to zero.

[3]Ore contains 18% to 20% manganese.

[4]Excludes refinery fuel and losses.

[5]Figure derived from a reported total for light refinery products by subtracting motor gasoline and white spirit (each reported separately) from reported total.

TRADE

Hungary's national economy is strongly foreign trade oriented, with 45% of the national income realized through foreign trade transactions. Hungarian trade in 1977 with centrally planned economy countries accounted for 57% (53% with CMEA nations); Western-developed countries, 34%; and developing countries, 9%. In 1977, trade turnover (exports and imports) increased by 16% to Ft506 billion in current prices, with imports surpassing exports by 6%. Trade with centrally planned economy countries continued to grow (16%) in 1977, at 14% for imports and 19% for exports. Exports to market-economy countries increased 12% from that of 1976, while imports increased 19%. Hungary in 1977 had a total foreign trade deficit of Ft29 billion, most of it from the market-economy (dollar) countries. The anticipated signing in 1978 of a bilateral U.S.-Hungarian Trade Agreement, providing for Most Favored Nation (MFN) tariff status will open up new trade opportunities in manufactured goods with a Western country. Bilateral trade may increase significantly in 1978 as the effects of the trade agreement become apparent. In 1977, U.S.-Hungarian trade was close to $211 million. Hungary imported almost $155 million worth of U.S. goods and exported $56 million worth to the United States. Overall, however, the United States share in Hungarian foreign trade in 1977 was extremely small (2% of total imports and 1% of exports).

In 1977, exports of metallurgical products to centrally planned economy countries increased 10%. Exports of ferrous metallurgical products to the U.S.S.R. increased more than 15%. Steel slabs were imported and in exchange sheet products were exported (the Danube Iron Works more than doubled their sheet goods exports). Exports to other countries also increased by 11%. Total exports of ferrous products to market-economy countries decreased 1% in 1977. Overall exports of ferrous products, however, increased 16,000 tons or 2%, even though export of rolled steel decreased from 801,000 tons in 1976 to 784,000 tons in 1977. Exports of bar-section products increased from 480,000 to 520,000 tons or 8% in 1977, while exports of sheet products dropped from 280,000 tons in 1976 to 236,000 tons or 16%

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in 1977. Exports of aluminum products in 1977 increased 35%, and exports of other nonferrous metal products increased 47%. Exports of aluminum products to the United States increased 29% in 1977.

The extent to which the 1977 price reductions affected the Hungarian ferrous metallurgical industry varied, but the metallurgical plants at Ózd (OKU) were the most severely hit. The price slump affected all their products, most of all the production of cable, since this product was in great demand worldwide. The 1977 profit of OKU decreased nearly 25% because of the unfavorable price situation. On the other hand, because of favorable market price situations, profits of the aluminum and other brands of nonferrous products developed as planned, with a favorable increase.

The U.S.S.R. is in first place in Hungarian foreign trade, with a 30% to 32% share. The largest export item to the U.S.S.R. is machinery and equipment, comprising approximately 35% of the total. Exports of rolling mill equipment were valued at Ft321 million in 1977 and metal working machinery at Ft659 million. The total value of Hungarian exports to the U.S.S.R was Ft3 billion.[13]

To meet Hungary's continuously rising demand for coal, petroleum, and natural gas, imports of the commodities were also increased during 1977. Rising prices for raw materials and fuels worldwide detrimentally affected the Hungarian economy in 1977 owing to the fact that 60% of all commodities have to be imported. Because of this, Hungary in 1977 initiated and imposed strict fuel consumption measures and regulations together with the reactivation of some mines and the introduction of improved management programs.

In addition to the import of large quantities of oil and gas from the U.S.S.R., various other raw materials are also imported such as the nonferrous metals, aluminum, rolled steel, and industrial timber. Import of mining machinery from the U.S.S.R. in 1977 amounted to Ft167 million. In 1978, Hungary plans to import 1 million tons of bituminous coal and coke from the U.S.S.R., most of its additional iron ore requirements, 6,500,000 tons of rolled steel, 15,000 tons of copper, 11,000 tons of lead, and many other nonferrous metals (including apatite concentrate and various finished fertilizers). As mentioned elsewhere, 4.4 billion kilowatthours of electrical energy is also to be imported from the U.S.S.R.[14]

Two-thirds of all Hungary's consumer goods are imported from the centrally planned economy countries from which Hungary plans to import 11% more goods in 1978 than in 1976. However, imports from the market-economy countries may increase by 7% to 8%. Imported goods make up more than 18% of all retail trade in Hungary.[15]

Table 2.—Hungary: Exports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Bauxite[2]	602,635	633,108	Czechoslovakia 328,680; East Germany 190,023; Poland 110,070.
Alumina:[2]			
Hydrate	r3,461	7,027	Finland 6,981.
Calcined	686,065	620,953	U.S.S.R. 333,450; Poland 146,186; Austria 84,681.
Metal including alloys:[2]			
Scrap	17,626	16,168	Austria 8,604; Italy 4,647; West Germany 2,485.
Unwrought	r62,806	54,989	East Germany 7,428; Poland 6,877; West Germany 5,731.
Semimanufactures	r46,628	46,775	Romania 20,624; East Germany 6,856; West Germany 3,028.
Chromium oxide and hydroxide	107	239	Yugoslavia 113; Italy 68; Netherlands 40.
Copper metal including alloys:			
Scrap	1,273	600	West Germany 456; Austria 119.
Unwrought	r5,597	9,050	West Germany 7,886; United Kingdom 555.
Semimanufactures	r1,307	2,109	West Germany 1,848.
Iron and steel metal:			
Scrap thousand tons	22	37	Italy 20; West Germany 9; Yugoslavia 6.
Pig iron[2] do	99	136	Austria 48; Italy 35; Poland 10.
Ferroalloys	--	388	Yugoslavia 338.

See footnotes at end of table.

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Table 2.—Hungary: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Iron and steel metal —Continued			
Steel, primary forms[2] thousand tons	80	41	Austria 10; West Germany 7.
Semimanufactures:			
Bars, rods, angles, shapes, sections[2] do	655	729	U.S.S.R. 115; Iran 66; West Germany 62; Poland 54.
Plates and sheets[2] do	218	355	Italy 51; West Germany 39; Romania 27; Switzerland 18.
Hoop and strip[2] do	15	25	Romania 5; West Germany 3; Algeria 2.
Rails and accessories do	NA	1	All to Italy.
Wire[2] do	15	27	Iran 9; Austria 7; Algeria 4.
Tubes and pipes[2] do	54	68	U.S.S.R. 10; East Germany 8.
Castings and forgings[2] do	12	13	Poland 3; West Germany 3; Bulgaria 1.
Other[2] do	23	26	West Germany 16; Sweden 3; Iran 3.
Total[2] do	r992	1,244	
Lead:			
Ore and concentrate	1,556	501	All to Belgium-Luxembourg.
Oxides	--	176	All to Italy.
Metal including alloys, scrap	--	197	Denmark 157; United Kingdom 40.
Magnesium metal	--	65	All to Yugoslavia.
Manganese ore and concentrate[2]	25,816	13,739	Czechoslovakia 8,517; West Germany 5,222.
Nickel metal including alloys:			
Scrap	r403	329	Netherlands 119; Yugoslavia 100; Switzerland 78.
Semimanufactures	r332	147	Sweden 80; Yugoslavia 57.
Platinum-group metals and silver:			
Waste and sweepings value, thousands	$2,119	$1,613	West Germany $812; United Kingdom $801.
Metals including alloys:			
Platinum group do	$76	$505	Italy $446.
Silver do	$483	$11	NA.
Tin metal including alloys	r60	60	United Kingdom 40; Italy 20.
Titanium oxides	--	695	All to Yugoslavia.
Zinc:			
Oxide	--	100	All to Belgium-Luxembourg.
Metal including alloys:			
Scrap	128	291	West Germany 178; Austria 113.
Unwrought	--	160	Sweden 100; Italy 60.
Other:			
Ore and concentrate, n.e.s.[2]	6,324	2,005	Romania 1,481; Belgium-Luxembourg 452.
Ash and residues containing unspecified nonferrous metals	13,562	11,245	Austria 8,390; West Germany 1,937.
Metals including alloys, n.e.s.:			
Metalloids	--	133	All to Switzerland.
Base metals value, thousands	$91	$668	West Germany $373; Yugoslavia $152.
NONMETALS			
Abrasives, grinding particles[2]	687	598	Bulgaria 576.
Asbestos	2,182	1,667	Belgium-Luxembourg 894; West Germany 773.
Cement, hydraulic[2] thousand tons	65	224	Yugoslavia 203.
Clay and clay products:			
Crude:[2]			
Bentonite	23,128	18,537	East Germany 15,423.
Kaolin	7,806	7,236	Czechoslovakia 5,450; West Germany 1,271.
Products:			
Refractory[2]	r25,019	24,498	West Germany 8,191; Romania 5,447; U.S.S.R. 2,477.
Nonrefractory	4,142	2,014	All to Austria.
Cryolite and chiolite	397	301	All to United States.
Diamond:			
Gem, not set or strung value, thousands	$328	$57	NA.
Industrial do	$185	$571	All to Belgium-Luxembourg.

See footnotes at end of table.

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Table 2.—Hungary: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Diatomite and other infusorial earth	2,468	2,288	Austria 2,228.
Fertilizer materials:			
Manufactured, unspecified[2]	r126,235	325,587	NA.
Ammonia[2]	37,601	101,653	Yugoslavia 52,442; Poland 20,058; East Germany 11,450.
Graphite, natural	--	40	All to Yugoslavia.
Pigments:			
Natural, crude[2]	r4,373	3,080	West Germany 685; Belgium-Luxembourg 623; United Kingdom 569.
Iron oxide, processed[2]	r1,522	2,137	Austria 1,001; West Germany 300; Denmark 249.
Precious and semiprecious stones value, thousands	--	$80	West Germany $29; Italy $27.
Sodium and potassium compounds, soda ash	--	1,662	All to West Germany.
Stone, sand and gravel:			
Crushed rock and dimension stone[2]	216,656	212,525	Yugoslavia 181,344; Czechoslovakia 21,374.
Bentonite[2]	23,128	18,537	East Germany 15,425; Poland 1,913.
Gravel[2] cubic meters	--	58,391	Czechoslovakia 54,191; Austria 4,200.
Limestone and dolomite	50,220	44,645	Yugoslavia 35,375; Poland 9,270.
Sand, excluding metal bearing:[2]			
Industrial	27,765	27,742	Yugoslavia 17,721; Austria 10,021.
Construction cubic meters	208,714	344,225	Czechoslovakia 339,354.
Sulfur:			
Elemental	--	2,801	All to Austria.
Sulfuric acid, oleum[2]	40,809	43,657	Yugoslavia 23,630; Romania 19,966.
Talc	--	100	All to Yugoslavia.
Other nonmetals, n.e.s.:			
Crude	40,095	46,496	Austria 22,130; West Germany 14,975.
Oxides of strontium, barium, magnesium	--	30	All to Yugoslavia.
Halide[2]	2,080	2,890	United Kingdom 2,250.
Ground minerals, n.e.s.[2]	86,410	91,709	Austria 23,766; East Germany 20,788; West Germany 13,620.
MINERAL FUELS AND RELATED MATERIALS			
Coal and briquets:[2]			
Lignite thousand tons	96	55	Austria 37; U.S.S.R. 18.
Coal briquets do.	30	16	Yugoslavia 15.
Coke, all types[2] do.	7	5	All to Yugoslavia.
Gas, natural[2] million cubic feet	157	318	Czechoslovakia 178; U.S.S.R. 140.
Peat and peat briquets[2]	1,538	1,082	Yugoslavia 788; Austria 263.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	r181	573	Austria 530.
Refinery products:			
Gasoline do.	1,326	r822	Austria 109.
Kerosine[2] do.	197	178	U.S.S.R. 103; Poland 13; East Germany 12.
Distillate fuel oil[2] do.	214	309	West Germany 129; U.S.S.R. 116.
Residual fuel oil[2] do.	1,119	1,417	Austria 1,184; Czechoslovakia 233.
Lubricants[2] do.	303	1,011	Austria 846; Yugoslavia 72.
Other:			
Liquefied petroleum gas[2] do.	194	519	West Germany 223; Yugoslavia 114; Austria 104.
Nonlubricating oils do.	33	34	Yugoslavia 23.
Mineral jelly and wax[2] do.	127	183	Italy 77; West Germany 18; Austria 12.
Bitumen[2] do.	364	234	Austria 110; West Germany 68.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	1,995	11,141	Italy 4,307; Yugoslavia 2,969; West Germany 2,145.

rRevised. NA Not available.

[1]Unless otherwise specified, data are partially or wholly compiled from the 1976 edition of the United Nations Supplement to the World Trade Annual, v. I, as well as official trade statistics of Bulgaria, Czechoslovakia, East Germany, Poland, and the U.S.S.R.

[2]Source: Official Hungarian Trade Statistics.

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Table 3.—Hungary: Imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Oxide and hydroxide	--	13	All from West Germany.
Metal including alloys:			
Unwrought[2]	146,860	155,514	U.S.S.R. 124,887; Poland 18,283; Romania 12,304.
Semimanufactures[2]	r9,916	7,526	Romania 5,056; East Germany 1,002.
Chromium, chromite	17,000	17,260	U.S.S.R. 17,000.
Copper:			
Copper sulfate[2]	4,377	3,282	U.S.S.R. 3,022.
Metal:			
Unwrought	[3]44,528	[3]30,248	Mainly from U.S.S.R.
Semimanufactures, castings and scrap	[2]6,750	[2]12,169	Do.
Iron and steel:			
Ore and concentrate[2]	4,261	4,234	U.S.S.R. 4,077; India 157.
Pyrite, roasted[2]	--	234,357	Romania 163,288; Poland 29,797; U.S.S.R. 23,416.
Metal:			
Pig iron[2] thousand tons	253	288	U.S.S.R. 246.
Ferroalloys[2] do	62	65	U.S.S.R. 39; Spain 15; Japan 5.
Steel, primary forms do	r284	307	U.S.S.R. 235; Romania 48.
Semimanufactures:			
Bars, rods, angles, shapes, sections[2] do	373	305	U.S.S.R. 224; Poland 21; Czechoslovakia 19.
Plates and sheets[2] do	395	393	U.S.S.R. 265; Poland 38; Czechoslovakia 22.
Hoop and strip[2] do	9	8	West Germany 3; Austria 2.
Rails and accessories do	NA	2	Mainly from Italy.
Wire[2] do	44	38	Czechoslovakia 18; U.S.S.R. 6; Austria 5.
Tubes and pipes[2] do	66	56	Italy 14; West Germany 12; Czechoslovakia 9.
Castings and forgings[2] do	7	5	Yugoslavia 3; West Germany 1.
Total do	r894	807	
Lead:			
Oxides	7,153	3,121	Austria 2,351; France 770.
Metal, unwrought	[2]12,392	[2]14,319	Mainly from U.S.S.R.
Magnesium metal including alloys, all forms	402	7	All from West Germany.
Manganese:			
Ore and concentrate[2]	14,914	15,130	All from U.S.S.R.
Oxides	--	240	All from Japan.
Molybdenum metal including alloys, all forms	28	36	Austria 25; Japan 11.
Nickel metal including alloys:			
Unwrought	r78	17	All from United Kingdom.
Semimanufactures	128	[3]163	Canada 109; Switzerland 18; West Germany 12.
Platinum-group metals including alloys, all forms value, thousands	$2,087	$2,510	West Germany $1,460; United Kingdom $822.
Silver metal including alloys, all forms do	$1,292	$524	West Germany $382; Belgium-Luxembourg $68.
Tin:			
Oxides	8	5	All from West Germany.
Metal, unwrought	[2]1,786	[2]1,718	United Kingdom 210; Belgium-Luxembourg 110; Denmark 77.
Titanium oxide	e r3,030	4,320	Italy 2,381; West Germany 1,023; Finland 916.
Tungsten metal, all forms	1	5	Austria 3.
Zinc:			
Oxide	307	561	Belgium-Luxembourg 511.
Metal:			
Blue powder	--	760	Yugoslavia 410; Belgium-Luxembourg 290.
Unwrought	[2]26,513	[2]28,735	Poland 6,140; Yugoslavia 5,011; Finland 4,507.
Semimanufactures	[2]7,275	[2]5,997	NA.
Other:			
Ores and concentrates, n.e.s.[2]	19,714	25,557	U.S.S.R. 18,143; Albania 6,836.
Metals including alloys, n.e.s.:			
Metalloids	663	1,246	Norway 620; Yugoslavia 403.
Base metals, n.e.s	[3]58	125	Japan 78; United Kingdom 30.

See footnotes at end of table.

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Table 3.—Hungary: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS			
Abrasives:			
Pumice, emery, natural corundum[2]	5,241	5,817	West Germany 3,104; Italy 1,613.
Dust and powder of precious and semiprecious stones			
value, thousands	--	$205	United Kingdom $168; Belgium-Luxembourg $35.
Grinding and polishing stones	688	724	Austria 318; West Germany 140; Yugoslavia 122.
Asbestos, crude	32,604	36,035	U.S.S.R. 31,150; Australia 4,510.
Barite and witherite	23,769	18,909	Yugoslavia 17,469; West Germany 1,440.
Cement, hydraulic[2] thousand tons	r974	981	U.S.S.R. 320; Romania 239; East Germany 199.
Chalk	1,202	1,320	All from Austria.
Clay and clay products:			
Crude:[2]			
Fuller's earth, chamotte and products	r80,716	73,155	Czechoslovakia 66,953; Poland 3,345.
Kaolin	28,533	28,797	Bulgaria 10,896; Czechoslovakia 8,587; East Germany 8,198.
Other	79,988	60,155	Czechoslovakia 30,991; Poland 15,852.
Products:			
Refractory[2]	54,966	42,143	Austria 23,073; West Germany 7,044; East Germany 3,679.
Nonrefractory	1,691	3,236	Italy 1,345; Sweden 1,190.
Diamond, industrial			
value, thousands	$1,197	$1,207	Belgium-Luxembourg $1,188.
Diatomite and other infusorial earth	--	2,071	Iceland 1,911; France 160.
Feldspar and fluorspar	13,693	7,124	Yugoslavia 3,300; Finland 1,541; Norway 1,223.
Fertilizer materials:			
Crude:			
Phosphatic thousand tons	702	504	U.S.S.R. 398; Algeria 72.
Potassic do	3	4	U.S.S.R. 2; East Germany 1.
Manufactured:[2]			
Nitrogenous do	411	437	U.S.S.R. 182; Belgium-Luxembourg 122; Czechoslovakia 64.
Phosphatic do	678	805	United States 452; U.S.S.R. 146; Yugoslavia 118.
Potassic do	1,373	1,172	East Germany 624; U.S.S.R. 529.
Other, including mixed do	178	94	Yugoslavia 36; West Germany 35; Austria 26.
Graphite, natural	199	155	All from West Germany.
Gypsum, calcined[2]	60,418	66,359	East Germany 29,154; Romania 28,248; Poland 8,728.
Iodine[2]	51	87	Japan 48; U.S.S.R. 28; Chile 10.
Lime, calcined[2]	31,074	19,954	Czechoslovakia 10,098; Romania 9,856.
Magnesite, calcined[2]	103,826	98,824	Czechoslovakia 68,928; U.S.S.R. 11,691.
Mica, crude and worked	66	51	United States 44; Switzerland 21.
Pigments:			
Natural, crude[2]	r20,027	20,688	West Germany 3,976; Italy 2,200; Czechoslovakia 1,813.
Iron oxides, processed[2]	r86	82	West Germany 30; United Kingdom 21.
Pyrite, gross weight[2]	87,652	81,417	All from U.S.S.R.
Salt[2]	r--	476,522	Romania 281,186; U.S.S.R. 107,522; Poland 74,069.
Sodium and potassium compounds:[2]			
Caustic soda	139,307	109,690	Romania 50,981; West Germany 20,503; Czechoslovakia 17,626.
Caustic potash	1,254	1,228	East Germany 1,129.
Soda ash	159,708	141,420	Bulgaria 77,316; Romania 35,700.
Stone, sand and gravel:			
Crushed rock and dimension stone[2]	230,488	217,543	Romania 106,875; Czechoslovakia 99,292.
Quartz and quartzite	1,298	1,537	West Germany 995; Netherlands 542.
Sand, industrial[2]	97,281	96,223	Czechoslovakia 74,021; East Germany 9,596.
Sulfur:[2]			
Elemental	208,567	143,447	Poland 115,372; U.S.S.R. 27,924.
Sulfuric acid	23,645	11,332	Poland 7,596; U.S.S.R. 3,736.
Talc and natural steatite	947	1,635	Austria 1,275; Italy 360.
Other nonmetals, n.e.s.:			
Oxides of strontium, barium, magnesium	327	319	France 180; West Germany 119.
Halogens	--	955	France 654; United Kingdom 301.
Ground minerals, n.e.s.[2]	41,919	44,702	Czechoslovakia 11,184; Bulgaria 8,970; East Germany 3,909.

See footnotes at end of table.

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Table 3.—Hungary: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS			
Carbon black[2]	14,481	16,198	U.S.S.R. 14,424; Romania 1,203.
Coal and briquets:[2]			
Anthracite and bituminous thousand tons	1,438	1,297	Czechoslovakia 562; Poland 375; U.S.S.R. 360.
Coal briquets do.	554	515	All from East Germany.
Coke, all types do.	1,335	1,458	U.S.S.R. 795; Czechoslovakia 305; Poland 246.
Gas, natural[2] million cubic feet	28,455	42,660	U.S.S.R. 35,315; Romania 7,063.
Petroleum:			
Crude[2] thousand 42-gallon barrels	62,153	64,657	U.S.S.R. 56,779; Iraq 5,940.
Refinery products:			
Gasoline[2] do.	1,288	2,274	U.S.S.R. 1,896; Czechoslovakia 342.
Kerosine[2] do.	1,494	1,151	All from U.S.S.R.
Distillate fuel oil[2] do.	2,431	2,509	U.S.S.R. 2,135.
Residual fuel oil[2] do.	867	744	U.S.S.R. 696; United Kingdom 48.
Lubricants including grease[2] do.	238	116	Romania 50; U.S.S.R. 23; Netherlands 20.
Other:			
Liquefied petroleum gas[2] do.	331	278	U.S.S.R. 220; East Germany 57.
Nonlubricating oils do.	11	7	Austria 4; Netherlands 3.
Mineral jelly and wax do.	1	1	NA.
Petroleum coke do.	6	6	Italy 5.
Bitumen[2] do.	410	207	Albania 206.
Bituminous mixtures do.	--	3	France 2.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	6,210	8,293	U.S.S.R. 5,890; West Germany 1,502; Italy 381.

[e]Estimated. [r]Revised. NA Not available.

[1]Unless otherwise specified, data are partially or wholly compiled from the 1976 edition of the United Nations Supplement to the World Trade Annual, v. I, as well as official trade statistics of Bulgaria, Czechoslovakia, East Germany, Poland, and the U.S.S.R.

[2]Source: Official Hungarian Trade Statistics.

[3]Partial figure, tonnage not available for all sources.

COMMODITY REVIEW

METALS

Aluminum.—Hungary in 1977 ranked 3rd in Europe and 7th in the world (3.6% of world output) in annual production of bauxite, 4th in Europe and 10th in the world (2.6%) in alumina, and 17th in Europe and 29th in the world (0.5%) in the production of aluminum. Hungary's bauxite reserves are a great national asset, despite the fact that the ore is only of medium grade, containing relatively high amounts of silica.

Production of bauxite in 1977 was almost 3 million tons, with little change from that of 1976. The production of alumina increased by 51,000 tons to 783,000 tons in 1977. Some analysts foresee an eventual production of 3.6 million tons per year of bauxite and 1 million tons per year of alumina, based on the present reserves. Hungary produced 71,335 tons of primary aluminum in 1977, compared with 70,499 tons in 1976. The major part of the 1977 bauxite production was processed to alumina, and 633,000 tons were exported. Hungarian aluminum smelters have an annual capacity of 70,000 tons, with no substantial changes foreseen in the immediate future. Since the 1962 long-term reciprocal agreement, shipments of alumina to the U.S.S.R. have grown steadily to a peak of 330,000 tons per year. After the alumina is smelted in the Volgograd Aluminum Works, the aluminum ingots (about 150,000 tons in 1977) are shipped back to Hungary as payment for its alumina. Because of high electrical power requirements (the electrolytic extraction of aluminum from alumina uses 15,000 to 16,000 kilowatt-hours of power per ton of

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aluminum metal) Hungary does not intend to expand its domestic smelters in the near future, but instead will seek CMEA agreements under which alumina will be shipped to other countries and then aluminum returned to Hungary for further processing. Hungary's consumption of aluminum was 292,939 tons in 1977 compared with 285,418 tons in 1976. Hungary's per capita domestic aluminum consumption in 1977 was about 13 kilograms. This consumption is expected to reach 20 kilograms by 1980 and 30 kilograms by 1990.

The Hungarian aluminum industry employs more than 20,0000 people, most of them working for the Hungarian Aluminum Trust (HAT). In 1977, as in the previous several years, the emphasis was on increased bauxite output and improved methods of alumina production. Reportedly, in the future, the attention will focus on the production of aluminum semifinished products. This will include the expansion of the Székesfehérvár light metal works. The annual output of rolled stock is to be raised by 43,500 tons of pressed and 21,000 tons of drawn products. Nine investment projects are also underway, the most significant being the plan to increase the capacity of the Ajka alumina factory by 80,000 tons and the construction of a foundry with a 2,700-ton-per-year-capacity. Two other investment projects include the 5,000-ton aluminum foil plant at the Köbánya metal works and the development of aluminum sulfate production at Magyaróvár. Most of these projects will be financed through loans to the State Development Bank of Hungary, made by the CMEA Investment Bank of Moscow, in the amount of Ft1.9 billion.[16] In general, the overall output by primary smelters lags behind production of most of the major aluminum-producing countries. For example, it has been 25 years since the last smelter was built in Hungary. Technical development began in the mid-1960's and by 1975 rolling mill output had reached 136,000 tons per year. The last stage of this expansion will start in 1978, after which production is expected to increase to 120,000 tons per year of rolled products, 58,000 to 60,000 tons of extrusions, and some 65,000 to 70,000 tons of wire. By the mid-1980's, the country's semifabricating capacity is expected to total 240,000 to 250,000 tons and perhaps double between 1990 and 2000.

The goal of the Hungarian bauxite mining is to stabilize production at the level of 3 to 3.5 million tons per year for a considerable time. At the present rate of mining, the deposits already discovered may be sufficient for several decades. In order to insure this long-range supply, known mining deposits are being reexamined and new exploration surveys have been initiated so that new mines may be opened such as those planned at Nagyegyhaza, Fenyöfö, and Nyirád. Bauxite is found primarily in the Bakony-Vértes highlands and occurs in sedimentary rocks of marine origin. Deposits are located conveniently close to the coal reserves and to the Danube River, thus being near the energy resources necessary for its processing and the eventual transport of the ore. The most significant occurrences of bauxite are in Vértes (near Gánt) and the Bakony Mountains (near Iskaszenterdö, Halimba, Iharkút, and Nyirád). The bauxites here overlay the dolomites and are capped by Lower Eocene strata, which in some localities are also coal bearing.

Prior to 1945, most of Hungary's bauxite ore was strip mined, but now the better ore is extracted mostly from underground operations. Workable ore deposits suitable for Bayer processing occur at depths of 150 to 300 meters or even deeper and the ore is of medium grade, the Al_2O_3:SiO_2 ratio being 7 to 8. However, unless special precautions are taken, the mines may be flooded permanently, requiring the lowering of the water level below the working access at considerable expense. Because Hungarian bauxite ores are of medium grade and the cost of underground operations is more than for strip mining, there was no other practical alternative than to modify the conventional process. This was supposedly successfully accomplished and the present production costs are competitive on the world market. Furthermore, four of Hungary's deposits may be mined out by 1978 and three others by 1982 and 1985.[17]

Plans for 1978 include development of an open pit bauxite mine at Iharkút, in the Veszprém province of northwestern Hungary. The deposit will be mined by the Bakony Bauxite Mining Enterprise over the next 5 years. Two other development projects scheduled for 1978 are the opening of the Bitó-2 mine at Kincsesbánya and the Deáki mine at Nyirád, with projected annual output of 500,000 and 660,500 tons of bauxite, respectively. With Soviet help, construction of the coal-bauxite mine at

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Nagyegyháza proceeded. Four exploratory shafts were sunk for the delineation of the potential 52-million-ton coal and 10-million-ton bauxite reserves. Mining of bauxite is to begin in 1981, and of coal in 1982, with the daily extraction of 2,000 tons and 6,000 tons, respectively.

In 1977, Hungary continued to help Yugoslavia in development of new bauxite mines and alumina production plants. This technical assistance program amounted to approximately $50 million since its inception in 1976. Hungary also receives special aluminum sheets from Czechoslovakia, the German Democratic Republic, and Austria in return for its semifabricated products exported to those countries. Negotiations were initiated in 1977 with Greece and the United States for various trade and cooperative agreements. The Aluterv Corp. of Hungary has been designing a 200,000-ton-capacity alumina plant to be built in Korba, India, and its eventual expansion. Hungarian enterprises were also supplying equipment and technicians for an alumina plant being built at Obrovac in Yugoslavia. At the request of the Leningrad Institute, the Aluterv Corp. designed another 600,000-ton-per-year-capacity plant to be built at Zvornik in Yugoslavia.

Exports of Hungarian aluminum to market-economy countries increased to $120 million in 1977, a 16% increase from that of the preceeding year. Total exports of ingots alone were 68,000 tons in 1977.[18] Most of the Hungarian aluminum is exported as semifinished and finished products, which in 1977 amounted to 30% to 35% of the total output. The major aluminum export items are motor castings, cables and conductors, window and door frames, kitchenware, liquid gas cylinders, collapsible tubes, and aerosol cans. Sales of bulk aluminum to Japan amounted to $1.5 million, compared with purchases of various goods from Japan on the order of $65 million. It is anticipated that 1978 export of combined goods to Japan will increase to 30%.

Copper.—Hungary's estimated 1977 mine output of contained copper was 1,010 tons, while 5,055 tons of copper concentrates were processed (a decrease of 26%). The declining trend of copper concentrate production has continued since 1975, when it was 7,018 tons. Hungary imported 50,000 tons of copper metal and products (up 18% from 1976) in 1977.[19]

Exploration for copper in 1977 continued in the Recsk area, Mátra Mountains, near the old Lahóca mine. According to some estimates, up to 2,500,000 tons of ore may be mined at 1.3% copper content; most of the ore grade, however, was averaging 0.4% to 0.7%. This expansion, including a concentrator and a smelter, may cost more than Ft20 billion. According to the present plans, the Recsk mine should be opened for operation in 1985 and full production is not expected to be attained until 1990. The project has been budgeted at Ft1.7 billion under the current 5-year (1976-80) plan, a record investment in Hungarian mining. Pyrite, lead, and zinc are also found at Recsk and are planned to be produced. Molybdenum content of the ore is about 60 parts per million, so that a 24% copper concentrate would contain 0.2% molybdenum which is recoverable. Rhenium also could be recovered from the Recsk concentrate, as a byproduct of the molybdenite concentrate.[20] Copper in the form of porphyritic chalcopyrite was found first at Recsk in 1967, which reportedly ranks among the top 20 deposits in the world. The top of the ore body is about 600 meters below surface. It is unique in that the central intrusive andesite ore body (chalcopyrite-copper-molybdenum porphyry) is zonally surrounded by an altered Triassic limestone (skarn) and mixed sulfide (Zn, Pb, Cu) ore mineralization. First drilling tests began in 1965, at a cost of several million forints. The Recsk mine is to be the deepest and the largest mine in Hungary. The old copper and gold mine at Lahóca is still in operation, but its output is decreasing rapidly, and most of its workers have been employed for years in the development of the new copper mine. Two vertical shafts, 8 meters in diameter each, have been sunk to a 1,200-meter depth. There will eventually be three levels at depths of 500, 700, and 900 meters (and perhaps even 1,200 meters) below datum. The work done has already involved the drilling of holes totaling more than 200 kilometers on a 250-meter grid. There are 135 holes with depths of 1,000 to 1,200 meters. Water is not a problem at Recsk, but high temperatures (to 51.5° C on the 900-meter level) may pose a problem, requiring intensive refrigeration and air conditioning. Most of the equipment suitable for mining under such conditions is not available in Hungary or in other CMEA

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countries. At present, Finnish, British, and Soviet machinery is being used in the development of the mine. In addition to the mine, a mill, a smelter, and possibly a sulfuric acid plant are to be built on the Recsk site. The construction of a smelter is under serious consideration; the most troublesome issue in its development, however, is the environmental consideration. The smelter complex is to be located in a recreational area in a narrow valley about 1 kilometer from the mine, which many environmentalists consider is too small and shallow for efficient desulfurization. However, the advantage of a smelter, and also a concentrator, in the immediate area of the mine may overweigh the environmental restrictions.

Gallium.—Production of gallium in 1977 was estimated at 2.8 tons (about 10% of the world production), an increase of 0.8 ton (40%) more than that of 1976. The gallium section of the Ajka alumina and aluminum plant produced more than half of Hungarian gallium and enlargement of the section continued in 1977. In 1977, Hungary planned to export 500 kilograms of gallium from Ajka to the U.S.S.R. The gallium production section at the Almásfüzitö alumina plant, based on Soviet technology, was under construction in 1977 and completion was slated for 1979.[21]

Gold.—Gold is produced as a byproduct of nonferrous metal mining. The largest gold producer is the old Lahóca mine near Recsk, which is now almost depleted. However, the new copper mine under development at Recsk may become a new source of Hungarian gold.

The Hungarian State mint processes about 2 tons of gold annually for domestic consumption and 100 kilograms for export. According to Hungarian reports, the volume of gold offered increases 15% each year. In 1975, retail outlets sold 610,000 pieces (no other quantities are available) of jewelry and objects made of gold.[22]

Iron Ore.—In 1977, iron ore production was 524,832 tons, including 52,000 tons of oxidized and 473,000 tons of sideritic iron ore (with a metal content of 116,000 tons). This is a 13% decline from the 1976 production and a 18% decline from the 1975 output. Most of the higher grade ore (4.3 million tons) was imported in 1977 from the U.S.S.R. Iron ore in Hungary has been mined for years in Rudabánya, approximately 35 kilometers northwest of Miskolc, in the northeastern part of the country. The iron ore is of hydrothermal origin and is of the ferrogenous or sideritic and limonitic (oxidized) type.

Iron and Steel.—In 1977, Hungary produced 2.3 million tons of pig iron, 3.7 million tons of crude steel, and 3.1 million tons of rolled steel products. Consumption of steel was 2.9 million tons in 1977, a 0.6% increase over that of the previous year. Most of the steel went into construction and manufacture of machinery, followed by the transportation industry. The following tabulation shows the 1974-77 trends in Hungarian iron and steel production:

	1974	1975	1976	1977
Pig iron production:				
Thousand tons	2,301	2,219	2,221	2,286
Percent change from previous year	+6.9	-3.6	--	+2.9
Crude steel production:				
Thousand tons	3,468	3,673	3,652	3,723
Percent change from previous year	+4.2	+5.9	-0.6	+1.9
Share of oxygen enrichment steel (percent)	46.0	46.1	43.6	87.9
Share of steel continuously cast (percent)	12.1	21.1	27.9	28.3
Hot-rolled steel production:				
Thousand tons	2,392	2,675	2,857	3,077
Percent change from previous year	+4.8	+11.8	+6.8	+7.7
Share of flat-rolled products (percent)	38.3	39.3	38.2	43.5
Steel castings, thousand tons	NA	57	60	59
Steel forgings, thousand tons	NA	162	164	159

NA Not available.

Sources: Iron and Steel International (London). April 1978, p. 68. Modified after United Nations, Secretariat of the Economic Commission for Europe, Steel Committee, New York, WP. 1/R. 6/Add. 3, 1978, p. 8.

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The ferrous metallurgical industry in 1977 had slightly overtaken its 1976 production in terms of tonnage. However, completion of many planned projects was delayed, mostly because the industry had undertaken more than it could handle. Wage increases in the metallurgical industry in 1977 averaged 7.5% to 9.0%. The iron and steel industry employed 79,100 people in 1977. The 1976-77 capital investment by various production sectors is shown in the following tabulation, in million forints:

Sector	1976	1977
Charge preparation	120	100
Pig iron production	150	130
Crude steel production	1,330	2,440
Steel rolling and finishing	375	420
Other installations	2,225	3,010
Total	4,200	6,100

Source: United Nations, Secretariat of the Economic Commission for Europe, Steel Committee, New York, WP. 1/R. 6/Add. 3, 1978, p. 8.

Of the total of 3,723,000 metric tons of raw steel in 1977, 3,307,000 tons were produced by the open-hearth process (89%) and 336,000 tons by the electric process. None of the steel in Hungary is produced by the Bessemer or the oxygen converter processes.

The country's three largest iron and steel enterprises, the Ózd Works, the Danube Iron Works (at Dunaújváros), and the Lenin Works (at Diósgyör) had a combined output of 3,723,000 tons of crude steel in 1977. These plants are undergoing modernization and when completed in 1981-82 their combined output will be increased by 1 million tons of steel annually. Since 1970, the annual growth rate of production has been only 3.8%. The expansion of open-hearth production with oxygen enrichment at the Ózd Works, which is to be completed in June of 1978, is to increase the works annual output from 1,100,000 to 1,400,000 tons. Most of the equipment for the oxygen plant, at a cost of Ft2.2 billion, has been imported from the German Democratic Republic and the smoke, gas, and dust separators have been supplied by the Federal Republic of Germany firm of Lurgi.

Plans for the installation of oxygen converters at the Lenin (Diósgyör) and Danube plants were made in 1976. Oxygen converter steel production is to be introduced to replace open-hearth production, and construction of the two units for this purpose is among the largest projects of the fifth 5-year plan. The unit at the Danube works will cost 9.4 billion forints and the unit at the Lenin works will cost 10 billion. The project will improve the quality of steel made at the Danube works, and it will increase the works' output by 64% from 1,100,000 to 1,800,000 tons. One of them will be completed in December 1981 and the other a year later. The designs and equipment will be supplied by the U.S.S.R. and the Federal Republic of Germany. An 80-ton-capacity oxygen converter with an annual capacity of 220,000 tons and an 80-ton electric furnace with a capacity of 200,000 tons per year are being built to replace the obsolete open-hearth furnaces at the Lenin works. A unit to produce high-quality steel is also to be installed. The equipment for the converter and for the steel shop are to be supplied by the Demag Company of the Federal Republic of Germany.

Construction of the two 130-ton Linz-Donawitz converters began in January 1977. The converters and the high-quality steel production unit (two 960-cubic-meter blast furnaces and one 1,700-cubic-meter furnace) are to be put into operation in October 1980; the electric furnace and a continuous casting unit is to begin operation in December 1982.[23]

The Csepel Metallurgical Works (CSW) produced over 3,000 tons more steel than planned in 1977 and its exports were 13% greater than in 1976. The enterprise's output value was reportedly Ft740 million more than in 1976. Csepel Iron and Steel Enterprise is also Hungary's largest producer of nonferrous metals, accounting for more than one-third of CSW's total production. The Csepel Nonferrous Plant intends to invest more than Ft2 billion during the current 5-year plan, so that its production will grow by 44% in 5 years.[24]

1977 was the first year of the 1976 Hungarian-Soviet metals agreement, pertaining to ferrous metal production during the 1976-80 period. Under this 5-year agreement, the U.S.S.R. will increase the yearly delivery of rolled steel to Hungary by approximately 600,000 to 650,000 tons and pig iron by 250,000 tons.[25]

Most of the raw materials processed by the Hungarian ferrous industry are imported. For example, some 4.3 million tons of iron ore and 1.2 million tons of coke are purchased annually from abroad, primarily from the U.S.S.R. Exports of rolled steel to

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market-economy countries exceeded 1 million tons in 1977 while 544,000 tons of rolled goods were imported. Hungary imports 86% of its iron ore, 70% of its coke, and 82% of its alloying materials. Imports of crude steel in 1977 were six times that of the previous year (42,858,000 tons).

The following tabulation shows the 1976-77 import statistics for iron and ferrous metals, in tons:

	1976	1977
Iron ore	4,234,000	4,258,000
Pig iron	288,052	227,435
Ferroalloys	65,207	58,811
Crude steel	7,162	42,858

Besides the export of 1,128,581 tons of rolled steel in 1977, Hungary also exported other steel products, as shown in the following tabulation, in tons:

	1976	1977
Hot-rolled semifinished steel products	40,000	28,000
Steel sheets	355,000	343,000
Steel tubes	54,602	53,014

Under the 1976-80 plan, the annual production of steel is to total 4,300,000 to 4,500,000 tons and 3,100,000 to 3,300,000 tons of rolled products. In 1978, almost 2,500,000 tons of pig iron and more than 3,500,000 tons of steel are to be produced and about Ft7 billion is to be invested on the modernization of the ferrous industry. Emphasis in 1978 will be placed on completion of industrial projects that will boost exports and meet the diversified needs of the domestic market.

Lead and Zinc.—The production of lead-zinc ore was 150,877 tons in 1977, reflecting a 5% (7,200 tons) upward change from 1976, but still supplying only a fraction of the country's domestic requirements.[26]

Most of the ore was mined at the Gyöngyösoroszi mine, near Recsk, in the Mátra Mountains, in northern Hungary, from which concentrates were sent to Poland and Bulgaria for smelting. This mine produces about 150,000 tons of ore per year. The opening of another lead-zinc mine is planned as part of the Recsk copper mine development, with an annual capacity of 1 to 1.5 million tons of crude ore, thus insuring 75% of domestic needs by 1990. However, sufficient resources supposedly are not available to open such a mine before the second half of the 1980's. No significant change in lead-zinc production change is anticipated in 1978. The following tabulation summarizes the 1975-77 statistics for lead and zinc, in tons:

	1975	1976	1977
Lead-zinc ore	146,649	143,655	150,877
Lead concentrate	1,773	1,711	2,550
Lead, mine output, metal content	887	850	1,275
Zinc concentrate	4,319	4,324	5,670
Zinc, mine output, metal content	2,160	2,162	2,835

Manganese.—Hungary produced 160,637 tons of manganese ore in 1977, of which 125,260 tons was oxide ore and 35,367 tons was carbonate. In the former case, there was a production increase of 10,000 tons, while in the latter there was a decrease of 16,000 tons compared with that of 1976. Part of the concentrated manganese ore was exported to the Federal Republic of Germany, Yugoslavia, and Poland.

In 1977, manganese ore continued to be mined at Úrkut, in the Transdanubia region. Hungary's estimated reserves of mostly carbonated manganese ore is 80 to 100 million tons. In the past 10 years, production has decreased to about 50% because domestic output of ferromanganese has virtually ended for environmental protection reasons. The incentive of an increase in the world market prices for manganese and especially ferromanganese in the past 2 or 3 years, however, has stimulated the investment potential by this industry. Thus, a new 35,000-ton-capacity plant is to be constructed in the future at a cost of Ft3 billion.

The following tabulation summarizes the 1975-77 statistics for manganese, in tons:

	1975	1976	1977
Oxide ore	127,660	114,450	125,260
Carbonate ore	54,705	50,624	35,367
Total	182,365	165,074	160,637
Manganese concentrate	131,000	125,000	120,000

Silver.—Silver is produced as a byproduct of nonferrous metal mining. The output of silver has been increasing slightly but steadily since 1974. The copper mine presently under development at Recsek may become a new source of Hungarian silver.

Titanium.—Hungary still does not have any titanium mines, even though there are

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a number of prospective ore deposits. The most significant is the wehrlite stock of Szarvaskö in the Matray/Tokaj Mountains of magmatic and partly hydrothermal origin.[27]

NONMETALS

The production of nonmetallic minerals increased in 1977, including such commodities as cement, bentonite, perlite, and glass and foundry sand. Hungary satisfies its domestic demand for most raw nonmetallic minerals and even exports some of them. More efficient domestic production of such minerals as dolomite, kaolin, and bentonite is also being planned. Most of this investment is to be in the improvement of processing technology and product diversification, which have not kept pace with the changing consumer demands.

Cement.—Hungary produced 4.6 million tons of cement in 1977, 7.5% higher than the 1976 production. During the year, cement was not readily available and there was a decline in prices, caused by fluctuating seasonal demand, storage problems, and low productivity.[28] Another cause of the cement shortage was inadequate transportation. For example, the Hejöcsaba cement plant was built at the edge of Miskolc partly because of the already existing rail system. About Ft100 million were spent on developing the freight yard. In 1977, the amount of stored cement at the Hejöcsaba plant began to grow, and by mid-summer, the Hungarian State Railroad (MAV) was unable to furnish the required daily 500 to 600 freight cars for the transport of 5,000 to 6,500 tons of cement. Instead, the plant informed its customers to pick up the cement themselves. Some 400 to 500 trucks per day came from Bácska, Szablocs, and Alföld, lining up at the plant gate the night before for loading the next morning. Because the plant begins full operation in 1978, this situation may be expected to worsen.[29] Partly because of this, several new cement plants were commissioned in 1977, and production and delivery schedules were tightened. Total consumption in 1977 was 5,111,000 tons, with per capita consumption being 482 kilograms. Hungary plans to produce 6 million tons of cement annually in 1980 and is expected to increase this to around 7 million tons annually by 1985. Imports and exports continued to increase in 1977 but at a lower rate than in the 1975-76 period, especially in the export sector. This stabilization in the export volumes is owing to the continued implementation of the 1976 foreign trade policy. In 1977, imports from the U.S.S.R., Romania, and the German Democratic Republic stood at 792,000,000 metric tons (up 4.5%) and total exports at 265,000 tons (up 18% from 1976 and up 71% from 1975).[30]

A new dry-process plant, designed to make Hungary self-sufficient in cement, was being built at Bélapátfalva in northern Hungary in 1977. It will be the fourth new dry-process plant built since 1960. The plant will cost some $220 million and is to produce 1.2 million tons of cement in 1978. Its two preheater kilns measure 5 by 75 meters and most of the plant's equipment came from the U.S.S.R. In 1977, trials began at a new prefabricated concrete plant at Bábolna, which will have an annual output of 3 million tons and will cost Ft165 million to build.[31]

Most of the newer cement plants in Hungary are located in the immediate area of ample limestone deposits (estimated reserves are sufficient for 40 to 70 years), and most of the fuels to fire the kilns come from the U.S.S.R. All cement plants in Hungary, except for the small experimental unit at Selyp, also produce lime as part of their operations.

In 1964, the Hungarian cement industry was reorganized and the 10 or so independent enterprises were merged into 1 central organization, Cement and Lime Works at Vac (Cement és Mészmüvek), under direct supervision of the Ministry of Construction. The following tabulation lists, and describes briefly, operational Hungarian cement plants:

Plant location	Annual capacity	Cost of construction[1]	Remarks
Bélapátfalva, 125 kilometers northeast of Budapest, near Miskolc	1.2 million tons	US$220 million Ft9 million.	To begin operating in 1978. Has two 5- by 75-meter preheaters. New dry process, oil and gas fuel.
Beremend, 45 kilometers south of Pecs	1.1 million tons	US$85 million Ft2.5 billion.	Began operating in 1972. Has two 4.4- by 65-meter kilns. Produces portland and blended (fly ash) cement. New dry process, oil fuel.

See footnotes at end of table.

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Plant location	Annual capacity	Cost of construction[1]	Remarks
Hejöcsaba, 150 kilometers northeast of Budapest, near Miskolc	1.3 million tons	US$230 million Ft5 to 6 billion.	Began operating in 1975, replacing an old wet-process facility. Has two 4.6- by 60-meter Polysius kilns with Dopol suspension preheaters and planetary coolers. New dry process, natural gas fuel.
Lábatlan, 20 kilometers north of Tatabánya	500,000 tons	--	Began operating in 1952. A 5-kiln (rotary) old wet-process plant. May be eventually converted to the new dry process or to output of high-sulfate resistant portland cement. Uses coal fuel.
Selyp, 50 kilometers north of Budapest	60,000 tons	--	Built in 1967. Small experimental cement plant for special products. One old kiln. Uses coal fuel.
Tatabánya, 80 kilometers west of Budapest	500,000 tons	US$10 million. Renovated in 1959.	May close by 1990 owing to age and lack of local limestone supplies. Old wet-process rotary 5-kiln plant. Produces portland and blended (fly ash) cement. Uses gas and coal fuel.
Vác, 50 kilometers north of Budapest	1.2 million tons	US$40 million	Construction started in 1960, began operating in 1963, full capacity reached in 1965. Has three 4- by 60-meter Lepol kilns and one 4- by 60-meter Polysius-Dopol kiln. Produces portland and blended (blast furnace slag) cement. New dry process, oil fuel.

[1]U.S. dollars and Hungarian forints (Ft) have not been converted owing to the wide variation in official exchange rates and because the quoted figures have been compiled from various sources.

Under Hungary's sixth 5-year plan (1981-85), Hungary may install a fifth new dry-process plant in northern Transdanubia, where at present large limestone deposits are being studied. This expansion is designed to achieve the previously planned cement self-sufficiency goal of 6 million tons annually by 1980.[32]

Environmental protection now plays a decisive and central role in the Hungarian cement industry. All cement plants constructed in the fourth 5-year plan period have been fitted with modern dust-collector and dust-binding installations. Dust remains a prime concern both inside and outside cement plant operations. At the new and largest Hejöcsaba plant, for example, 13% of total investment was reportedly spent on the reduction of dust pollution.

Clays.—*Bentonite.*—Production of crude bentonite in Hungary was 80,003 tons in 1977, from which 51,636 tons of marketable product was produced. A wide range of bentonite clays are produced in Hungary for use as a foundry binder. With the exception of the natural, ground, calcium montmorillonite, all grades are produced by the sodium exchange technique and grinding. Two grades of soda-activated bentonite (good yield and low-water loss) are produced for use as well oil-drilling muds.

More than three-fourths of the bentonite is mined from an open pit at Hercegköves and from a smaller open pit in the Rátka Újhegy area, Zemplén Mountains of northeastern Hungary. All of the new bentonite is processed at Mád, together with the kaolin. New deposits found at Ond and Istenmezeje are still being examined for their eventual extraction.

Kaolin.—Production of kaolin declined in 1977 to 71,455 tons, 6,000 tons of which was processed. Almost all of the kaolin mines in Hungary are located on the southern and southeastern flanks of the Zemplén Mountains and kaolin is sometimes mined and processed at the same localities and plants as the bentonite. Most of the larger mines are open pit but the Szegilony and Füzérradvány mines are underground. The mined kaolin is processed locally at the Mád, Bodrogszegi, Szegi, and Erdöbénye plants. There are sufficient reserves of clays in Hungary to last for the next 20 to 25 years.

Diatomite.—A new plant producing calcined diatomaceous earth was under construction in 1977 in Erdóbénye. It is designed for producing plant insecticides for agri-

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cultural use. Its production will result in considerable import savings. Most of Hungary's diatomite consists of the *Navicula* and *Melo sira* species of diatom, and the manufactured products are suitable for a wide range of applications.[33]

Fertilizer Materials.—In 1977 Hungary produced 679,000 tons of nitrogenous and phosphatic fertilizer materials, in terms of nutrient content. The production of nitrogenous fertilizer continued to rise, while phosphatic fertilizer output continued to decline. The total production of bulk fertilizer in 1977, including anhydrous ammonia, was 4,265,000 tons. The 1977 economic plan envisaged the production of 1.7 million tons of fertilizers in nutrient content, as contrasted to the 1.6 million tons of actual production.[34]

Hungary depends on imports for all of its potassic, most of its phosphatic, and some of its nitrogenous fertilizers. Some 55% of Hungary's requirement for fertilizer is now produced domestically, while 30% is imported from the centrally planned economy countries, 15% from the U.S.S.R., and some from Algeria; the potassic fertilizer comes from the German Democratic Republic and the U.S.S.R. Hungary exports large quantities of fertilizer mostly to the Federal Republic of Germany and Yugoslavia. The following tabulation shows 1975-77 import statistics and trends for phosphate rock and apatite concentrate in thousand tons:

	1975	1976	1977
Morocco	32,118	33,858	86,437
Algeria	52,545	71,841	109,854
Jordan	--	--	3,613
U.S.S.R. and Vietnam	617,702	398,146	446,512
Total	702,365	503,845	646,416

Source: Modification of data in British Sulfur Corporation Ltd., London, Report, 1977.

Pét Nitrogen Works, located in Pétfürdö near Varpalota southwest of Budapest, is the largest chemical fertilizer plant in Hungary. The plant was put into full operation in late 1977 and was expected to produce at least 600,000 tons of compound (NPK) fertilizers (containing nitrogen, phosphorus, potassium), 200,000 tons of urea (carbamide), 240,000 tons of calcium ammonium nitrate, and 220,000 tons of nitrogen.[35]

The other Hungarian fertilizer plants are the Borsod and Tisza chemical complexes, both located near Miskolc, northeast of Budapest. The Tisza chemical complex reported a production of 500,000 tons of ammonium nitrate in 1977, more than double that its first year of operation in 1964.[36] The Borsod chemical complex was nearing the completion of a large-scale reconstruction in 1977, which will enable the Kazincbarcika complex to produce 1,000 tons more ammonia and 2,800 tons more nitrogen fertilizer annually. It was reported, however, that construction of the Borsod chemical complex's No. 4 nitrogen plant was postponed for 1 year.[37]

In the 1985-90 period, Hungarian fertilizer consumption is expected to double, making it highly possible that imports will continue. According to the forecasts of various Hungarian institutions, the demand for fertilizers in terms of nutrient content should be 1.2 million tons by 1980, at 290 to 300 kilograms per hectare. This is expected to grow to 2.5 million tons by 1985 and 3 million tons by 1990. Hungarians expect that eventually the phosphate content of fertilizers will decline and that foliar fertilization and systematic micronutrient additions will become the general practice. The following tabulation shows the planned production of various fertilizers after 1980, in thousand tons of nutrient content:

	N	P_2O_5	K_2O	Total	Percent
Ammonium nitrate (34% N)	200	--	--	200	15.4
Calcium ammonium nitrate (25% N)	210	--	--	210	16.2
Urea (46% N)	170	--	--	170	13.1
Ammonium sulfate (20.5% N)	10	--	--	10	.8
Superphosphate (18% P_2O_5)	--	200	--	200	15.4
NPK 16-16-16	80	80	80	240	18.4
NPK 10-30-20	25	75	50	150	11.5
NPK 11-22-15	27.5	55	37.5	120	9.2
Total	722.5	410	167.5	1,300	100.0

Source: Chemical Age, New York, Nov. 18, 1977, p. 12.

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Reportedly, a group of French companies has been awarded a contract by Hungary's Chemokomplex, valued at $5 million, to build a phosphoric acid plant and a 30,000-ton-per-year sodium tripolyphosphate plant at Szolnok, scheduled for completion in 1979. Elemental phosphorus will be supplied to the plant by the U.S.S.R. from Kara-tau.[38]

Perlite.—The production of perlite in 1977 increased to 103,270 tons or 270,000 cubic meters, mostly from the Pálháza works in the Zemplén Mountains. Reportedly, perlite reserves at Pálháza are sufficient to supply the building industry with basic insulating materials and cement admixtures until the end of this century. Hungary ranks fifth or sixth in the world in perlite production, making it a leading producer of this commodity. In 1977, 75% of perlite produced was exported to Austria and the German Democratic Republic. Because of the demand for perlite in the building industry and because Hungary is favored with plentiful reserves, perlite may in the near future be playing a more significant role in Hungary's overall economy. In addition to Pálháza, several mines are located at Teikibánya and Sátoraljaújhely, with processing plants at Belegrádpuszta, Zalaegerszeg, and Hegyalja regions. Mining at Pálháza began in 1954 as an open pit operation, as are most of perlite mines. The ore is blasted in shallow benches and then transported in trucks to crushing and sizing plants.

Sand and Gravel.—Production of glass and molding sand increased in 1977 by 30% and 7%, respectively, mostly owing to the expansion of the Fehérvárcsurgó plant. Production of building sand and gravel, on the other hand, decreased by 50% and 34%, respectively. A 50% production expansion of glass sand is planned for the current 5-year plan. In 1977, work continued at Pécsvárad on the plant processing sand with a high feldspar content designed for use by the ceramic industry.

MINERAL FUELS

The overwhelming majority of Hungary's energy is imported from the CMEA countries, primarily from the U.S.S.R. Additionally, lesser amounts are also imported from market economy countries. In 1977, coal accounted for 37% and oil and natural gas for 61% of all energy sources. Other energy sources, such as hydropower and fuelwood made up the remaining 2%.

Domestic production accounts for 60% of Hungary's energy sources and imports for 40%, primarily from the U.S.S.R. Coal mining output was 25.5 million tons, of which 8 million tons of lignite came from opencast mines, and 17 million tons of bituminous and brown coal came from underground mines. Oil refineries processed 72 million barrels of oil, the bulk of which was imported from the U.S.S.R., and 17 million barrels was produced domestically; 253,464 million cubic feet of natural gas was produced and an additional 42 billion cubic feet of gas was imported.

The total energy balance for 1976 and 1977 is shown in table 4.

Table 4.—Hungary: Primary energy balance for 1976 and 1977

(Million tons of standard coal equivalent[1])

Year	Total primary energy	Coal (lignite, anthracite, bituminous), coke, and briquets	Crude oil and petroleum products	Natural and associated gas	Fuelwood	Hydroelectric and other power
1976:						
Production	r26.5	r14.8	r3.2	r8.1	0.4	--
Imports	r18.1	r1.7	r14.3	r1.6	--	r.5
Exports	r.7	r--	r.6	r.1	--	--
Apparent consumption	r43.9	r16.5	r16.9	r9.6	.4	r.5
1977:p						
Production	27.3	14.9	3.2	8.8	.4	--
Imports	18.9	1.9	14.8	1.6	--	.6
Exports	.6	--	.5	.1	--	--
Apparent consumption	45.6	16.8	17.5	10.3	.4	.6

pPreliminary. rRevised.

[1]1 ton standard coal equivalent (SCE)=7,000,000 kilocalories. Conversion factors used are as follows: Hard coal, 1.0; lignite and brown coal, 0.5; recovered slurries, 0.515; briquets and household coke, 0.67; coke, 0.9; crude oil, 1.47; refinery products, 1.53; natural gas, 1.33 (per thousand cubic meters); manufactured gas, 0.6; and hydroelectric power, 0.125 (per thousand kilowatt-hours).

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Energy consumption in 1977 was 4% more than that of 1976 and a similar increase is expected in 1978. Consumption statistics for the major energy sources are given in the following tabulation:

	1960	1970	1975	1976	1977
Coal ---------- million tons	28.1	29.6	26.6	27.3	27.4
Petroleum ---------- thousand tons	2,608	6,038	9,657	9,929	10,057
Natural gas ---------- million cubic meters	--	3,667	5,919	7,230	7,780

Sources: Statisztikai Evkönyv 1977 (Statistical Yearbook 1977), Budapest, 1978. Statistical Pocket Book of Hungary 1978, Budapest, 1978.

During the fifth 5-year plan period, Hungary intends to put 40% of its total investments into the energy sector. Furthermore, the Ministry of Heavy Industry, called for large-scale economy measures in power consumption by both the public and the industry. In the 1980's, the amount of liquid hydrocarbons consumed by the power stations is to be reduced and replaced by the greater use of coal and nuclear power. According to the Ministry, coal production in 1978 is expected to be approximately 25.4 million tons, petroleum production is expected to surpass 2.1 million tons, and natural gas production is expected to surpass 7 billion cubic meters.[39]

Hungary imports nearly 83,000 megawatt-hours of electric energy from Bulgaria, Romania, Czechoslovakia, Poland, and the German Democratic Republic, through the CMEA electrical energy system. In addition, almost 20% of the energy is acquired directly from the U.S.S.R. In 1977, work was nearing completion on a 750-kilovolt electric transmission line which will operate between Vinnyica and Albertirsa. Also nearing completion was the Orenburg ("Szövetség") natural gas pipeline (a CMEA project) and the Adriatic petroleum pipeline (a Yugoslavia-Czechoslovakia-Hungary project). The first 440-megawatt stage of the 1,760-megawatt nuclear power station at Paks, now under construction, is to go into operation by December 1980, and other plants are being planned.[40] Except for one 860-megawatt oil-fueled plant already under construction, it appears that no further power stations are to be built which depend either on hydrocarbon fuels or on imported coal.[41] The long-range outlook for the Hungarian economy is that its energy needs will double in one or two decades and that the entire proven fuel reserve is not even sufficient for the country's needs till the end of the century. Thus, the development of energy from new sources and with new methods is seriously considered by Hungary. One new source under consideration is geothermal energy. Nearly one-half (40,800 square kilometers) of Hungary's territory is suitable for the economic production of geothermal energy. The production is especially possible from the Upper Pannonian formations. Hot springs exist in more than two-thirds of the country, with water temperatures at 40°, 70°, and even 90° C.[42] Presently, Hungary has 500 operating geothermal wells and another 19,500 are possible. If the geothermal energy development program is implemented by 1985, it is expected to save Hungary 536,000 tons of oil.[43]

Coal.—In 1977, the production of all types of coal and lignite reached almost 25.5 million tons, exceeding that of 1976 only by 0.78%. A higher coal production was emphasized in 1977 owing to shortages and increasing fuel costs.

Hungarian coal and lignite reserves are estimated at 2.5 billion tons. Lignite west of the Danube can be strip mined and is older and of better quality than that east of it which occurs in Lower Tertiary Paleocene deposits. Two-thirds of Hungarian lignite is mined from this basin. The other one-third is made up of lignite and bituminous deposits from the Bakony region north of the Dunántúl highlands and from the southern foothills of Mátra and Bükk, northeast of Budapest.

Geological surveys and exploration programs for coal in 1977 were expedited in order to discover new deposits and to update the estimates of the known reserves. According to a geological survey, a good quality minable lignite deposit of 130 million tons was found at Mány, near Tatabánya. Tatabánya is the largest coal mining town in Hungary, having 73,000 inhabitants. To date, the Tatabánya coal basin has produc-

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ed 160 million tons from 1 strip mine and 9 underground mines, worked by 13,000 miners. Annual production is about 2.5 million tons, but reserves are decreasing and mining is being shifted to the newly discovered Csordakút-Négyegyháza-Mány basin in Transdanubia. A 6-million-ton annual production is forecast from that field, which is part of the Eocene Program. Two other new lignite mines, with a total annual capacity of 8 million tons, were being developed in the Transdanubian region in 1977.

The shortage of railroad freight cars and coal storage space continued, causing a loss of more than 100,000 tons in deliveries in 1977. Three mines have also been closed in Borsod County. The county produced almost 5.3 million tons of coal in 1977 (200,000 tons more than planned) and projects production of 5,130,000 tons for 1978. Ultimately, the production of Hungarian coal is expected to increase to 30 million tons per year by 1980, a considerable increase from 24.9 million tons per year in 1975 when production was the lowest. In the long run, the production is envisaged to reach the 40-million-ton-per-year mark, even though 1978 production is expected to be only 26 million tons.

From the maximum coal production of 31.5 million tons in 1964-65, the demand for coal has dropped in subsequent years owing to the switch to the use of hydrocarbon energy. In the last few years, however, the demand for coal was on the upswing again and in order to prepare for this rejuvenated coal consumption, the Eocene Program has been initiated. Under this program, openings of new mines are planned which will boost the coal production in the next decade. This program will develop the brown coal deposits of Eocene and Miocene age in the Tatabánya area, the Pannonian (Pliocene) lignite deposits in the Mátra Mountains and the foreland of the Bükk Mountains, and the Liassic (Jurassic) coking coal in the Mecsek Mountains. Of these deposits, one-third is to be extracted by underground mining and two-thirds by open pit excavation. This program, for example, will replace the depleted coal reserves at Komárom Corontz and coal mining in the Tatabánya-Oroszlány-Dorog region will be renewed. Mines at Márkus-Hegy, Nagyegyháza, Mány and Lencse-Hegy II, and mines at Balinka and Dudar are expected to produce 9 million tons of coal per year (half of the production from the underground mines). Most of this lignite will be supplied to the thermal powerplants, such as the one at Bicske. The long-range prospects of the Eocene Program is to open new mines that will supply Hungary with coal and lignite for the next 100 years.[44]

The Eocene Program is Hungary's most ambitious and grandiose multimineral exploration and development program. In order to achieve raw mineral self-sufficiency, a broad cooperative thrust is being applied to mine more than one mineral from the same mine, such as coal and bauxite, for example. Besides these "two-product" mines, the development objectives also include the simultaneous construction of cement and alumina plants and electric powerplants near the new mines. Such multi-industry cooperation is expected to contribute to the country's domestic raw materials and energy independence. As a direct result of this program, the industrial growth of Komárom County, the geographical focal point of this development, has grown considerably. The first comprehensive study was completed in March 1970, which examined the feasibility of simultaneous mining of coal and bauxite occurring in the same stratigraphical section. One such area is the Csordakút-Nagyegyháza-Mány coal basin. Coal of Eocene age (hence, the Eocene Program) occurs here close to the surface and is separated from the Jurassic bauxite below by dolomite beds.[45] Thus, it is not the discovery of new deposits that may be so significant in the Eocene Program, as the cooperative mining and construction ventures.

Natural Gas.—In 1977, Hungary produced 253.5 billion cubic feet of natural gas and imported 42.7 billion cubic feet. Most of the gas (59%) was produced from the Szeged area in southeastern Hungary, in the immediate vicinity of the highest oil-producing Algyö field. Fields in the Szeged-Algyö region hold almost 50% of all the oil and more than 60% of gas reserves. In addition, small fields of natural gas, mostly associated with oil, exist all over Hungary. Some of the fields are in the northwest, essentially the continuation of the Vienna oil and gas basin; other gasfields are found even in the immediate vicinity of the capital and in the Tisza-Vasvár area in the northeast. On the basis of known reserves and present levels of consumption, oil and gas will be available for the next 20 years. In the long run, production of 2 million tons per year of oil

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is foreseen.

Capital investment in the Hungarian gas industry for the 1976-80 period has been at a level of Ft20 billion. In addition to its domestic production, the Fraternity pipeline, opened in 1975, continues to steadily channel over 35.3 billion cubic feet of natural gas annually from the U.S.S.R. An additional 7.1 billion cubic feet is also received from Romania and large amounts will be delivered in 1978-79 through the Orenburg line from the U.S.S.R. Under that project, which is being completed with the participation of several CMEA countries, Hungary is to obtain more than 134 billion cubic feet of gas annually from the U.S.S.R. as compensation for its investment and work on the project.

In order to avert a gas shortage, an underground storage was completed at Pusztaederics in 1977. At the Ebes field, in the northern Great Plain, a natural gas processing plant was installed. Reportedly, the second natural gas processing unit of the Szeged Petroleum and Natural Gas Industrial Establishment processed 2.4 million cubic feet of propane-butane in 1977, compared with 1.7 million cubic feet in 1976. The plant invested Ft515 million into its natural gas processing unit No. II. Investment into the carbon dioxide enhanced recovery installations in the Lóvaszi field amounted to Ft123 million. The cost of three DHR-160 drilling rigs by the Lowlands Exploration and Development Establishment was Ft123 million. Only two small gasfields were developed in 1977, and their output was only slightly more than 35 million cubic feet.[46]

Petroleum.—In 1977, Hungary produced 2.2 million tons of oil. For domestic requirements, an additional 8.5 million tons were imported, primarily from the U.S.S.R. (7.7 million tons). The 2-million-ton-per-year production level was first reached in Hungary in 1975 and has since been increasing steadily. The four operating Hungarian oil refineries produced a total of 10 million tons of products in 1977, compared with 9.8 million tons in 1976.

Most of Hungarian oil reserves used to be concentrated in the southwestern part of the country, in the petroliferous region of Zala (Dunántúl), but these are now almost depleted. Presently, Nezötur, southeast of Budapest, and the Szeged-Algyö area in the south, are the main oil basins in the Great Alföld. Of the 2.2 million tons of oil produced in 1977, 48% came from the Algyö field. Production declined from the Transdanubia fields and from some of the smaller fields in the Great Hungarian Plain. This decline, however, was compensated by the increased production from the Szeged-Móraváros and Ferencszállás fields. Production losses in 1977 were cut by the introduction of new recovery techniques. The new method of oil displacement by carbon dioxide, for example, was in the advanced stage of development. This method was tested in the Szeged-Algyö fields in 1977 and almost 200 wells are to use this method by the end of 1978.

Production by refineries in 1977 remained almost at last year's level, with gasoline at 17 million barrels, residual fuel oil at 23 million barrels, and distillate fuel oil at 26 million barrels. Hungary relies heavily on the U.S.S.R. for crude oil supplies. Under a joint agreement, more than 40 million tons of crude oil are to be delivered by the U.S.S.R. to Hungary in 1976-80, with an additional 6 million tons of various crude oil products.

The throughput of operating crude oil pipeline systems (Friendship I, Friendship II, and Algyö-Százhalombatta) was increased in 1977 to 95% of their designed capacity. In addition, the Adriatic pipeline was in the final stages of completion and will contribute significantly to the oil transport in the future. The pipeline is being constructed in order to obtain additional supplies of petroleum from the Middle East and North Africa. Czechoslovakia and Yugoslavia are in partnership with Hungary in this joint venture. The pipeline's projected annual capacity is 34 million tons, with Hungary and Czechoslovakia receiving 5 million tons each, and the remaining 24 million tons going to Yugoslavia.

In 1977, one of the most significant projects was the commissioning of the Eastern Product Pipeline. This line is intended to transport the refined products imported from the U.S.S.R. to Hungary. Another important project (Ft112 million) was the construction of a gasoline processing unit at the Komárom Petroleum Refining Co., designed to produce high-octane gasoline. The company also commissioned the construction of three gas-oil storage tanks, at 20,000 cubic meters capacity each. At Tisza Petroleum Refining Co., four fuel oil tanks, at 30,000 cubic meters each, were also commissioned in 1977.

Domestic marketing of refined products

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in Hungary is directed by the Mineral Oil Marketing Co. (AFOR). The oil and gas exports are carried out by several foreign trade companies, the Mineralimpex and Chemokomplex being the foremost.[47]

Uranium.—The search for radioactive minerals in Hungary began some 30 years ago in the Valence Mountains in the western part of the country. Subsequently, the areas of search have spread to Koszeg Mountains and to Pécs in the Mecsek area, under close Soviet supervision and support. In the Mecsek Mountains, ore is extracted from a depth of approximately 1,100 meters, concentrated in several sandstone horizons of Permian age. The Mecsek uranium mine is the second deepest mine in Hungary (the deepest, more than 1,200 meters, is the Recsk copper mine). The uranium mine, "Petöfi No.4/11th Congress Seam," located near Petoc in the Mecsek Mountains, was opened in 1971 after the closure of mine No. 1 by the Mecsek Ore Mining Enterprise due to depleted ore deposits. Mine No. 1 was the first mine where uranium was mined in Hungary in the early 1950's. The No. 4 mine is more than 1,000 meters deep and the miners work in temperatures of 42° C. More than 90% of the uranium is exported to the U.S.S.R. In order to increase production, development of the No. 5 uranium mine started in 1977.

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[1]Physical scientist, Branch of Foreign Data.

[2]Hungarian forints (Ft) have not been converted into U.S. dollars owing to the wide variation between the official exchange rate and the values used for some transactions. On June 30, 1977, the exchange rate was Ft39 = US$1.00 (Ft100 = US$2.56), as reported by the United Nations Economic and Social Council.

[3]Munkaügyi Szemle (Labor Review), Budapest. No. 1-2, January-February 1978, pp. 1-4.
Népszabadság (People's Freedom), Budapest. Feb. 5, 1978, pp. 1-3.

[4]Pénzügyi Szemle (Financial Review), Budapest. No. 4, April 1978, pp. 290-293.

[5]Ipargazdasag (Industrial Economy), Budapest. No. 6, June 1978, pp. 43-48.

[6]Second work cited in footnote 4.

[7]Kohászat (Metallurgy), Budapest. V. 3, No. 8, 1978, pp. 366-370.

[8]CMEA—the Council for Mutual Economic Assistance—comprises the following countries: Bulgaria, Cuba, Czechoslovakia, the German Democratic Republic, Hungary, Mongolia, Poland, Romania, and the U.S.S.R.

[9]Magyar Hirlap (Hungarian News Bulletin), Budapest. July 9, 1978, p. 5.

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[14]Külgazdaság (Foreign Trade), Budapest. No. 6, June 1978, pp. 3-11.

[15]Világgazdaság (World Economy), Budapest. Oct. 20, 1978, p. 3.

[16]Figyelö (Observer), Budapest. Aug. 23, 1978, p. 5.

[17]Magyar Aluminium (Hungarian Aluminum), Budapest. V. 15, No. 9, 1978, p. 263.

[18]Hungary (Budapest). June 1978, pp. 34-35.

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[23]Müszaki Elet (Technical Life), Budapest. June 17, 1977, p. 19.
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Népszava (People's Voice), Budapest. July 18, 1977, p. 3.

[24]Népszabadság (People's Freedom), Budapest. Nov. 9, 1977, p. 10.

[25]Magyar Hirlap (Hungarian News Bulletin), Budapest. Apr. 21, 1977, p. 4.

[26]Work cited in footnote 19.

[27]A Nehezipari Müszaki Egyetem Közlemenyei (Bulletin of the University of Heavy Industry), Miskolc. Mining Series, v. 24, Issue 1-2, 1978, pp. 95-98.

[28]Népszabadság (People's Freedom), Budapest. Oct. 13, 1977, p. 5.

[29]Modification of data in CEMBUREAU (the European Cement Association), Paris. World Cement Market in Figures, 1913-1977. Statistical Review No. 35, Special Edition, 1978.

[30]Magyar Hirlap (Hungarian News Bulletin), Budapest. Nov. 17, 1977, p. 7.

[31]Rock Products Chicago. April 1977, p. 89.

[32]Work cited in footnote 37, pp. 114-127.

[33]Work cited in footnote 12.

[34]Népszabadság (People's Freedom), Budapest. May 4, 1977, p. 10.

[35]Magyar Hirlap (Hungarian News Bulletin), Budapest. Sept. 18, 1976, p. 7.
Hungarian Foreign Trade, Budapest. No. 3, 1977.

[36]Népszabadság (People's Freedom), Budapest. Feb. 9, 1977, p. 1.

[37]Magyar Hirlap (Hungarian News Bulletin), Budapest. Aug. 24, 1977, p. 4.

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[39]Work cited in footnote 10.

[40]Népszabadság (People's Freedom), Budapest. Oct. 13, 1977, p. 1.

[41]Petroleum Economist, London. V. 45, No. 2, pp. 47-49.

[42]Világgazdaság (World Economy), Budapest. July 23, 1977, p. 3.

[43]Magyar Tudomány (Hungarian Science), Budapest. No. 2, 1978, pp. 104-110.

[44]Hungarian Review, Budapest. December 1978, pp. 11-12.

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The Mineral Industry of Iceland

By Joseph B. Huvos[1]

In 1977, Iceland, with no significant minerals but with abundant hydroelectric and geothermal energy, had a slightly improved economy, but inflation was at 31% and unemployment was maintained artificially at 0.5%.

The gross national product (GNP) was about $1.3 billion.[2 3] Two important events in Iceland's mineral industry during the year were the commissioning of a major hydroelectric project and continued construction of a State-controlled ferroalloy plant.

PRODUCTION AND TRADE

There was an increase in production of primary aluminum, Iceland's most valuable mineral product during the year. Production of mineral commodities is shown in table 1.

There was no significant change in Iceland's foreign trade pattern in 1977. Mineral commodity exports remained mainly aluminum and small amounts of scrap, cement, and diatomite. Principal mineral imports remained petroleum products, alumina, cryolite, and salt.

No mineral commodities were exported to the United States in 1976, and the major items of the small mineral imports from the United States were petroleum products and some steel semimanufactures and metals. Iceland's mineral commodity trade in 1975 and 1976 is shown in table 2, and trade with the United States in 1976 is shown in table 3.

Table 1.—Iceland: Production of mineral commodities

Commodity and unit of measure	1975	1976	1977[p]
Aluminum metal, primary ---- metric tons	61,800	65,300	72,800
Cement, hydraulic ---- thousand metric tons	159	145	139
Diatomite[1] ---- metric tons	20,264	22,699	20,985
Fertilizer materials, manufactured, gross weight:			
Nitrogenous ---- do	9,680	12,892	8,897
Other ---- do	[r]25,284	29,866	36,088
Pumice[1] ---- do	3,540	1,529	7,586
Sand and gravel:			
Calcareous ---- thousand cubic meters	110	105	111
Other ---- thousand metric tons	[e]500	513	773
Stone:			
Crushed and broken ---- do	33	28	30
Scoria ---- do	92	93	100

[e]Estimate. [p]Preliminary. [r]Revised.
[1]Exports.

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Table 2.—Iceland: Mineral commodity trade

(Metric tons unless otherwise specified)

EXPORTS			
Commodity		1975	1976
METALS			
Aluminum metal including alloys, unwrought		43,636	78,625
Iron and steel scrap		3,455	2,992
Nonferrous metal scrap and metal-bearing residues		--	684
NONMETALS			
Diatomite		20,264	22,699
Pumice		3,540	1,529

IMPORTS			
Commodity		1975	1976
METALS			
Aluminum:			
Alumina		169,919	130,966
Metal including alloys:			
Unwrought		30	91
Semimanufactures		950	741
Chromium oxide and hydroxide		--	7
Copper metal including alloys, unwrought and semimanufactures		244	152
Iron and steel metal:			
Pig iron, ferroalloys, similar materials		219	234
Steel, primary forms		1,392	446
Semimanufactures:			
Bars, rods, angles, shapes, sections		18,612	17,609
Universals, plates, sheets		9,936	10,304
Hoop and strip		410	311
Rails and accessories		--	20
Wire		467	235
Tubes, pipes, fittings		5,450	6,590
Total		34,875	35,069
Lead:			
Oxide		--	12
Metal including alloys:			
Unwrought		--	83
Semimanufactures		--	2
Mercury	76-pound flasks	--	6
Nickel metal including alloys, all forms		--	2
Platinum-group and silver metals including alloys:			
Platinum-group	value, thousands	$78	$77
Silver	do	$268	$217
Tin metal including alloys, unwrought and semimanufactures		--	12
Titanium oxide		641	884
Tungsten metal including alloys, all forms	value	--	$1,219
Zinc:			
Oxide		--	9
Metal including alloys:			
Blue powder		--	3
Unwrought		43	63
Semimanufactures		46	18
Other:			
Oxides, hydroxides, peroxides of metals		--	12
Metals including alloys, all forms:			
Metalloids		39	40
Base metals including alloys, all forms, n.e.s		56	(1)
NONMETALS			
Abrasives, natural, n.e.s		15	25
Asbestos		--	9
Barite and witherite		--	23
Boron materials		--	11
Cement, hydraulic		80,423	24,258
Chalk		--	223
Clays and clay products (including all refractory brick):			
Crude		317	378
Products:			
Refractory (including nonclay brick)		1,495	2,180
Nonrefractory		813	827
Cryolite and chiolite		361	2,489
Diamond, all grades	value	--	$6,856
Diatomite and other infusorial earth		--	1
Fertilizer materials:			
Crude		--	2
Manufactured:			
Nitrogenous		125	88
Phosphatic		896	1,493
Potassic		3,873	6,555
Other including mixed		32,182	31,705
Ammonia		1,927	3,126
Gypsum and plaster		10,986	6,873
Lime		1,086	905
Mica, all forms		--	11

See footnotes at end of table.

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Table 2.—Iceland: Mineral commodity trade —Continued

(Metric tons unless otherwise specified)

Commodity		IMPORTS 1975	IMPORTS 1976
NONMETALS —Continued			
Pigments, mineral, including processed iron oxides		641	29
Precious and semiprecious stones, except diamond	value, thousands	--	$14
Salt and brine		56,829	35,930
Sodium and potassium compounds, n.e.s		335	393
Stone, sand and gravel:			
Dimension stone		--	26
Worked stone		34	53
Dolomite, chiefly refractory grade		--	30
Gravel and crushed rock		--	2,987
Limestone		--	30
Quartz and quartzite		--	156
Sand, excluding metal bearing		--	156
Sulfur, all forms[2]		--	390
Talc, steatite, pyrophyllite		--	74
Other:			
Crude		--	4
Oxides and hydroxides of magnesium, strontium, barium		--	2
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s		842	443
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		--	10
Carbon black and gas carbon		--	19
Coal, coke, peat		--	314
Hydrogen, helium, rare gases	value	--	$4,769
Petroleum refinery products:			
Gasoline, aviation and motor	thousand 42-gallon barrels	742	679
Kerosine and jet fuel	do.	401	141
Distillate fuel oil	do.	2,453	2,144
Residual fuel oil	do.	543	683
Lubricants	do.	39	41
Mineral jelly and wax	do.	1	3
Other:			
Liquefied petroleum gas	do.	12	12
Nonlubricating oils, n.e.s	do.	10	12
Pitch coke	do.	10	6
Bitumen and other residues	do.	72	35
Unspecified	do.	4	3
Total	do.	4,287	3,759
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		232	245

[1]Less than 1/2 unit.
[2]Mainly sulfuric acid.

Table 3.—Iceland: Mineral trade with the United States, 1976[1]

Commodity	Imports	
	Quantity (metric tons)	Value, thousands
METALS		
Aluminum metal including alloys	6	$13
Copper metal including alloys	29	97
Iron and steel semimanufactures:		
Bars and angles	1	2
Plates and sheets	26	55
Wire	3	5
Tubes and pipes	217	286
Castings and forgings	NA	1
Zinc metal including alloys	3	5
NONMETALS		
Stone, sand and gravel	32	5
MINERAL FUELS AND RELATED MATERIALS		
Petroleum refinery products:		
Gasoline	1,266	146
Jet fuel	8,460	889
Residual fuel oil	924	826
Total	XX	2,330

NA Not available. XX Not applicable.
[1]Iceland recorded no exports to the United States in 1976.
Source: U.S. Department of Commerce, Bureau of the Census.

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COMMODITY REVIEW

METALS

Aluminum.—During 1977, Norsk Hydro AS and the Icelandic Government discussed the possibility of building a 100,000-ton-per-year aluminum smelter at an unspecified location.

Work was underway to install a $36 million gas emission purification system at Alusuisse's Straumsvik plant, scheduled for completion in 1980. Alusuisse continued to operate the only aluminum reduction plant in Iceland, the 76,000-ton-per-year facility at Straumsvik, south of Reykjavik.

Ferroalloys.—Construction continued at Icelandic Alloy's Hvalfjördur ferroalloy plant north of Reykjavik, with production scheduled to start in 1979 at the rate of 25,000 tons per year and expected to increase to 50,000 tons later. The Icelandic State holds a majority interest in the company, with Elkem-Spigerverket A/S of Norway as the minority partner. National Power Co. held jointly by the State and the city of Reykjavik, is to supply the 68 megawatts of electric power needed to operate the plant.

NONMETALS

Cement.—Sementverksmidja Rikisins (Iceland State Cement Works) operated the country's only cement plant, located at Akranes near Reykjavik. The plant operated virtually at full capacity during the year.

Diatomite.—In 1977, repeated earthquakes damaged the Lake Myvatn diatomite plant, but production was not drastically interrupted. Controlling interest in the plant is held by the Icelandic State, and Johns-Manville Corp. of New York owns most of the balance. Almost all heat energy used at the plant comes from geothermal steam.

MINERAL FUELS

In 1977, hydroelectric and geothermal power continued to supply almost one-half of Iceland's energy needs. The remainder was supplied by imported petroleum products, mainly from the U.S.S.R. with some from Portugal and the United States. Iceland's supply and consumption of fuel and power in 1976 and 1977 is shown in table 4.

Geothermal Energy.—Repairs to the Krafla geothermal power station in North Iceland, damaged in a volcanic eruption, were to be completed in 1978. Funds for drilling new steam wells necessary to bring the plant to full power had not yet been allocated.

Owing to its location on the mid-Atlantic Ridge, Iceland has a very large geothermal potential, estimated at 3,200 megawatts.[4] At present, about 315 megawatts are used, mostly for space heating in the Reykjavik area and at Namafjall in the northeast.

Hydroelectric Power.—A 50-megawatt section of the 150-megawatt Sigalda hydroelectric plant started operation in 1977. The plant, located 130 kilometers east of Reykjavik, is owned and operated jointly by the Icelandic State and the city of Reykjavik.

Preparations for the Hrauneyjafoss hydroelectric project in southern Iceland, about 160 kilometers east of Reykjavik, continued, with bids being received for the 140-megawatt project.

At year end, installed hydroelectric capacity of the country was estimated at 600 megawatts-electric.

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[1]Physical scientist, Branch of Foreign Data.

[2]U.S. Embassy, Reykjavik, Iceland. Foreign Economic Trends and Their Implications for the U.S.: Iceland. U.S. Department of Commerce, November 1977.

[3]Where necessary, values have been converted from Icelandic kronas (IKr) to U.S. dollars at the rate of IKr196=US$1.00.

[4]Geothermal Energy Magazine. V. 5, No. 5, May 1977, p. 21.

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Table 4.—Iceland: Supply and apparent consumption of fuels and power for 1976 and 1977

(Million tons of standard coal equivalent[1])

	Total energy	Petroleum and refinery products	Hydroelectric power	Geothermal energy
1976:				
Production[2]	0.7	--	0.3	[e]0.4
Imports	.8	0.8	--	--
Exports	--	--	--	--
Apparent consumption	1.5	.8	.3	.4
1977:[p]				
Production[2]	.9	--	.4	[e].5
Imports	1.0	1.0	--	--
Exports	--	--	--	--
Apparent consumption	1.9	1.0	.4	.5

[e]Estimate. [p]Preliminary.
[1]1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2]Primary energy only.
Source: Statistical Bureau of Iceland. Statistical Bulletin. V.47, No. 1, February 1978.

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The Mineral Industry of India

By Gordon L. Kinney[1] and Francis E. Shafer[2]

In March 1977, India held a general election in which the Congress Party was ousted for the first time since the country became independent in 1947 and Morarji Dasai replaced Indira Gandhi as prime minister. The new Janata (People's) Party pledged to stimulate the growth of rural areas and encourage cottage and small-scale industry at the apparent expense of the heavy industry sector. How this change would affect the mineral industry in India was not clear at yearend.

The mineral industry accounted for only about 1.4% of India's gross national product (GNP) but was an important sector of the economy and employed about 4% of the organized labor force in 1977. Employment that depended directly on domestic mineral output, however, was several times that figure; sectors that depend on mineral output included steel, aluminum, copper, and zinc production and associated heavy manufacturing, transportation, and rural power development.

India has large reserves of coal, iron ore, bauxite, barite, mica, manganese, chromite, and heavy mineral sands, and was a substantial exporter of iron ore, manganese, mica, and chromite. Oil and natural gas output showed a marked increase compared with that of the previous year.

There were about 3,600 working mines, of which 880 were mechanized and produced 85% of the value of the total mineral production. India's per capita consumption of minerals was very low, about 1% that of the United States.

The Geological Survey of India (GSI), Mineral Exploration Corp. (MEC), National Mineral Development Corp. (NMDC), the various state mineral development corporations, Oil and Natural Gas Commission (ONGC), and other Government groups were all pursuing active programs of exploration and development of the country's mineral resources. The most important developments were confirmation of very large deposits of high-grade bauxite near the east coast and the development of the Bombay High oil and natural gas fields off the Indian west coast.

The Government's 1978-83 draft plan provided for over $4 billion for the nonfuel-mineral-related sector, a 30% increase over the figure in the previous plan period. About 72% of the expenditures were earmarked for the steel sector, 16% for iron ore, and 12% for the nonferrous metals. The major objective of the plan was to complete ongoing projects, but funds also have been programed for establishing two alumina plants on the east coast and expanding the country's steelmaking capacity. The plan also included an export target of 40 million tons per year of iron ore by the end of FY 1982. Where resources are not abundant, the Government Planning Commission recommended importing more ore, utilizing low-grade deposits to a greater degree, and limiting production to actual domestic needs.

India's petroleum production increased during 1977, but consumption increased even faster, causing imports to rise accordingly. Metallic and nonmetallic mineral production dropped slightly in value from the previous year due primarily to a slowing of industrial growth caused, in part, by power shortages and labor problems. Coal production remained static despite planned increases. Output was affected by power shortages, poor industrial relations, rail bottlenecks, and a shortage of explosives. As a result, coal shortages developed, affecting industrial consumers and further aggravating the electric power shortages.

The Indian economy in 1977[3] showed a growth of 7%. In current prices, India's GNP was $100.85 billion[4] in 1977 or $60.4 billion at constant 1970 prices. India's agri-

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cultural sector accounted for nearly 45% of the GNP and was, therefore, a key factor in the economy. Growth during the year was due mainly to a very favorable summer monsoon season, which produced record crops, including a total foodgrain harvest of over 125 million tons.[5] The Government places a high priority on agriculture in the 1978-82 5-year plan. According to figures, 43% of development funds in the draft plan were to be spent on agriculture and related supporting activities. Irrigation and flood control projects were to be emphasized, thus lowering the country's strong dependence on a favorable monsoon season for the production of adequate food crops. The plan called for the irrigation of an additional 36 million acres during the 5 years, bringing the total to nearly 150 million acres. Other priorities included the doubling of nitrogen fertilizer production and the expansion of rural electrification to an additional 100,000 villages and 2 million electric water pumps.

Despite the recent gain in agricultural production, major problems continue to afflict the rural countryside. Growing population pressures (growth rate was nearly 2.5% per year) have resulted in higher rates of rural unemployment and underemployment, a declining average size of farms, and deforestation and severe overgrazing, resulting in increased soil erosion. Water was often used inefficiently or was not available in many places. Government programs for distribution of surplus land to landless laborers, credit to the rural poor, and food for work projects were proving very difficult to implement effectively.

The industrial sector showed a rather unsatisfactory 3.4% growth during 1977 compared with the 10.4% growth in 1976. The reasons were varied, but perhaps the underlying problem was an insufficient demand for many consumer goods, caused by over 50% of the population living below the poverty level. Other reasons were depressed investments in new projects owing to considerable underutilized capacity, fear of possible nationalizations, labor unrest, rail and water transport bottlenecks, and increasingly serious power shortages.

The chronic shortage of electric power continued to be a major problem facing the Indian economy. There was a 7-billion-kilowatt-hour shortfall between supply and demand during 1977. Shortages occurred in about one-half of the States during the year, with power cuts ranging from 5% to 55% for industrial consumers. The most affected industries were aluminum, iron and steel, cement, and petrochemicals. Even the agricultural sector was beginning to be affected, despite the fact that the Indian Government continued to give it priority whenever possible.

The Government's ambitious power-development plan called for an increase in the installed electrical capacity from 14,000 megawatts in 1970 to 45,000 megawatts by 1983. At yearend 1977, the installed capacity reportedly reached 25,180 megawatts as compared with 23,700 megawatts in 1976. Another 520 megawatts was tested but not fully commissioned. Despite the 6% increase in capacity, total power generated increased only 1% to 90 billion kilowatt-hours during 1977. This small percentage reflected breakdowns in thermal units due to obsolete equipment and poor maintenance, a low water level at the hydroelectric stations, and labor unrest. Between 1976 and 1977, the equipment and maintenance problems resulted in a 4% decline of the average-capacity-utilization factor.

The power shortages continued through yearend, and there was little chance of any significant improvement in the short term. Shortages and cutoffs in some of the major urban centers may very well increase in both magnitude and duration before the overall situation begins to improve.

PRODUCTION

The mineral industry of India contributed about $1.46 billion to the economy in 1977 or about 1.4% of the GNP. This was a decline of about 1% compared with the 1976 production value. Solid fuels contributed about 58% of the total value followed by petroleum and natural gas with 20%, metallic minerals with 14%, and nonmetallics with 8%. Iron ore furnished about 50% of the value of metallic minerals, followed by copper ore with 13%, manganese and chromium ores with 10% each, gold ores with 8%, and zinc with 5%. Limestone accounted for about 50% of the value of the nonmetallics, followed by phosphorite with 18%, dolomite with 5%, and magnesite with 4%.

Mining and quarrying employed an average of 762,000 persons in the public sector and 123,000 persons in the private sector during 1977.[6] This was roughly 4% of the total organized[7] employment of major industries and services.

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Bihar was the leading producer among States, accounting for about 29% of the total value of mineral production in 1977, followed by Madhya Pradesh and West Bengal with 14% each, Gujarat with 12%, Assam with 10%, and Andhra Pradesh and Orissa with 5% each. Nearly all of Gujarat's and Assam's values were from petroleum and natural gas, while Bihar produced mostly coal, iron ore, copper ore, and bauxite.

Marginal production gains were recorded by copper ore, graphite, gypsum, lead and zinc concentrates, and phosphate rock, but output levels of apatite, chromite, mica, dolomite, iron ore, limestone, manganese, and pyrites were down. The iron ore decline was due mainly to the recession in the international steel market rather than from a lack of production capability.

In terms of metal output, both zinc and lead increased by over one-third, but plants continued to operate far below capacity. Total crude steel output increased slightly to over 9.9 million tons. Aluminum production, suffering most from power interruptions, declined 13%, and blister copper was off nearly 5%. In view of the continuing electric power and labor problems, the 1978 outlook appeared even less promising than 1977. Higher imports were anticipated to meet production shortfalls.

The Planning Commission projected sizable supply-demand gaps of over 70,000 tons of aluminum, 40,000 tons of copper, 55,000 tons of zinc, and 45,000 tons of lead by FY 1982. If these gaps are realized, it would be a serious blow to India's balance-of-trade situation and its economy in general.

Table 1.—India: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Aluminum:			
Bauxite, gross weight thousand tons	1,273	1,448	1,511
Alumina, gross weight do	337	442	[e]390
Metal, primary only	159,678	209,549	183,841
Antimony metal, regulus	238	404	186
Cadmium metal	53	34	44
Chromium: Chromite, gross weight	500,294	402,118	350,698
Copper:			
Mine output, metal content	[r]24,240	28,800	31,200
Metal:			
Smelter	[r]22,000	24,800	23,500
Refined	16,344	20,028	22,800
Gold, smelter troy ounces	90,826	100,696	91,758
Iron and steel:			
Iron ore and concentrate, gross weight thousand tons	41,405	43,868	42,307
Pig iron[2] do	[r]8,290	9,776	10,100
Ferroalloys:			
Ferrochrome	10,128	17,059	17,372
Ferromanganese	142,398	175,506	166,857
Ferrosilicon	39,972	53,970	44,475
Ferrosilicochrome	3,200	5,002	4,155
Other	339	303	349
Steel ingots[3] thousand tons	7,802	9,194	9,700
Steel castings do	60	61	66
Semimanufactures:[4]			
Angles, shapes, sections do	893	908	1,012
Bars and rods do	2,315	2,584	2,312
Plates and sheets:			
Uncoated do	815	970	1,019
Galvanized do	163	178	192
Tinplate do	107	114	110
Hoop, strip, strapping, skelp do	653	1,092	1,166
Rails and accessories do	314	376	497
Wire do	266	321	326
Special steels, form not specified do	221	322	352
Total do	5,747	6,815	6,986
Lead:			
Mine output, metal content	11,111	12,120	12,720
Metal, primary only	4,769	5,435	7,588
Magnesium	--	30	107
Manganese ore and concentrate, gross weight thousand tons	1,576	1,835	1,774
Rare-earth metals: Monazite concentrate, gross weight[e]	3,000	3,000	3,000
Selenium kilograms	--	723	4,285
Silver, mine and smelter output thousand troy ounces	83	102	425

See footnotes at end of table.

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Table 1.—India: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS —Continued			
Titanium:			
Ilmenite concentrate, gross weight[e]	82,000	82,000	82,000
Rutile concentrate, gross weight[e]	3,600	3,600	3,600
Tungsten, mine output, metal content	20	23	28
Zinc:			
Mine output, metal content	22,838	27,408	32,500
Metal	25,727	26,785	36,005
Zircon[e]	10,300	10,300	10,300
NONMETALS			
Abrasives, natural, n.e.s.:			
Corundum, natural	311	526	1,150
Garnet	4,437	2,075	1,837
Jasper	NA	1,593	1,441
Asbestos	19,957	24,119	20,298
Barite	175,275	235,068	315,146
Cement, hydraulic thousand tons	16,176	18,640	19,060
Chalk	45,069	61,349	61,361
Clays:			
Ball clay	25,941	35,209	42,618
Diaspore	2,564	10,090	6,652
Fire clay	650,000	666,000	678,000
Kaolin:			
Direct salable, crude thousand tons	260	335	323
Processed do	97	103	89
Total salable do	357	438	412
Other do	165	242	127
Diamond:			
Gem[e] thousand carats	17	17	15
Industrial[e] do	3	3	3
Total do	20	20	18
Feldspar	42,472	55,307	53,289
Fertilizer materials:			
Crude, phosphatic:			
Apatite	30,338	38,280	35,357
Phosphatic rock	429,049	644,058	686,668
Manufactured:[5]			
Nitrogenous:[6]			
Gross weight thousand tons	3,462	4,120	4,155
Nitrogen content do	1,300	1,608	1,659
Phosphatic:[7]			
Gross weight do	467	790	995
P_2O_5 content do	75	127	161
Mixed:[8]			
Gross weight do	1,118	1,419	1,988
Nitrogen content do	208	254	340
P_2O_5 content do	245	351	509
K_2O equivalent content do	93	144	216
Fluorspar:			
Acid grade	4,961	9,709	9,067
Metallurgical grade	5,256	4,271	6,157
Total, all grades	10,217	12,407	15,224
Concentrates (graded)	3,067	3,643	3,567
Gem stones, excluding diamond:			
Agate (including chalcedony pebble)	1,588	3,128	1,442
Emerald, crude carats	32,280	825	330
Garnet kilograms	420	3,673	3,637
Graphite	20,897	38,273	40,681
Gypsum thousand tons	815	727	768
Kyanite and related materials:			
Andalusite	NA	NA	288
Kyanite	52,364	48,779	42,832
Sillimanite	8,178	14,859	14,894
Lime	380,000	182,000	[e]182,000
Magnesite	313,453	329,698	402,694
Mica, processed:			
Exports:			
Blocks	574	889	--
Splittings	3,518	3,530	--
Condenser films	136	150	7
Washers and disks	99	151	188
Waste and scrap	22,457	8,055	11,005
Powder	7,878	9,239	10,670

See footnotes at end of table.

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Table 1.—India: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
NONMETALS —Continued			
Mica, processed —Continued			
Exports —Continued			
Micanite and other built-up mica	14	33	41
Other	3	147	48
Total	34,679	22,194	21,959
Domestic use[e]	3,600	3,600	3,600
Grand total	38,279	25,794	25,559
Pigments, natural: Ocher	98,495	92,053	68,010
Pyrite:			
Gross weight	50,633	47,531	38,050
Sulfur content	18,822	19,222	[e]14,080
Salt, all types thousand tons	6,168	4,438	3,759
Stone and sand and gravel:			
Calcite	13,690	21,567	26,377
Dolomite thousand tons	1,450	1,886	1,858
Limestone do	26,061	29,891	29,555
Quartz and quartzite do	321	414	341
Sand:			
Calcareous do	902	1,074	898
Other do	1,585	1,756	1,620
Slate	3,417	3,843	3,985
Talc and related materials:			
Pyrophyllite	14,994	34,080	32,879
Steatite (soapstone)	213,000	220,000	211,000
Vermiculite	2,111	3,435	2,680
Wollastonite	1,102	4,541	3,329
MINERAL FUELS AND RELATED MATERIALS			
Carbon black[e]	52,000	59,000	59,000
Coal:			
Bituminous thousand tons	95,931	100,876	100,297
Lignite do	2,822	3,895	3,632
Total do	98,753	104,771	103,929
Coke:			
Coke oven and beehive do	8,846	[er]9,620	10,000
Gashouse do	50	48	[e]50
Other, soft[e] do	3,700	3,700	3,700
Total do	12,596	13,368	13,750
Gas, natural:			
Gross production million cubic feet	81,585	85,108	NA
Marketable production[9] do	35,244	53,466	54,561
Petroleum:			
Crude oil thousand 42-gallon barrels	61,611	64,632	75,787
Refinery products:			
Gasoline do	10,396	11,169	11,645
Kerosine do	--	--	19,282
Jet fuel do	25,307	27,980	8,160
Distillate fuel oil do	53,175	54,518	60,993
Residual fuel oil do	33,859	32,947	34,938
Lubricants do	2,485	2,380	2,828
Other do	25,069	27,991	32,459
Refinery fuel and losses do	10,917	11,067	10,778
Total do	161,208	168,052	181,083

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, bromine, other clays (bentonite, fuller's earth, and common), other gem stones (aquamarine, ruby, and spinel), and uranium are also produced, but production is not reported and available information is inadequate for formulation of reliable estimates of output levels. In 1975, production of 6,514 metric tons of uranium ore containing about 3 metric tons of U_3O_8 was reported from two mines, but this output was only a part of total national production.

[2]Data are for calendar years; data for fiscal years beginning April 1 of years stated are as follows, in thousand metric tons: 1975—8,340; 1976—10,022.

[3]Data are for calendar years; data for fiscal years beginning April 1 of years stated are as follows, in thousand metric tons: 1975—7,186; 1976—7,910; 1977—9,670.

[4]Data are for fiscal years beginning April 1 of years stated.

[5]Data from the Fertilizer Association of India, Fertilizer Statistics, 1977-78, New Delhi, 1978, pp. I/37-I/39 and I/178-I/179; figures presented are for years beginning April 1 of that stated.

[6]Includes ammonium sulfate, ammonium sulfate-nitrate, urea, calcium ammonium nitrate, and ammonium chloride.

[7]Includes single superphosphate, pelophos, and triple superphosphate.

[8]Includes all reported varieties of nitrogenous-phosphatic and nitrogenous-phosphatic-potassic (NP and NPK) mixed fertilizers.

[9]Includes reinjected gas.

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TRADE

India's world trade had a total value of $13.46 billion in 1977, an increase of nearly 12% over that of 1976. The figure represented over 13% of the country's GNP. After a modest, positive balance of trade in 1976, imports surged ahead of exports and at yearend 1977, there was a negative trade balance of over $800 million.[s]

Total exports were valued at $6.32 billion and included gems and jewelry ($470 million), iron ore ($295 million), steel ($268 million), base metals ($153 million), and silver ($100 million). Chromite, manganese ore, and mica were also important exports during 1977.

The total value of imports was $7.14 billion, a nearly 20% increase over that of 1976. The imports of raw materials, essential commodities, and capital goods will continue to rise and could result in a significantly larger trade deficit in 1978.

Mineral imports were dominated by petroleum in 1977 as they have been in recent years. Despite a 17% increase in domestic production, India's bill for nearly 15 million tons of imported crude oil was $1.5 billion, and for 2.7 million tons of refined products, an additional $340 million. Iran and Iraq supplied about two-thirds of the total crude oil imports, and the U.S.S.R. supplied most of the refined products.

India's major nonfuel minerals imports were uncut diamonds, specialty steels, lead and zinc concentrates, rock phosphate, and sulfur.

Table 2.—India: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS			
Aluminum:			
Bauxite and concentrate		14,320	21,190
Aluminum oxide and hydroxide		42,817	40,699
Metal and alloys:			
Unwrought		15	34,814
Semimanufactures		3,448	6,357
Cadmium metal including alloys, all forms		--	45
Chromium ore and concentrate		350,128	277,798
Copper:			
Copper sulfate		1	(1)
Metal and alloys:			
Unwrought		10	(1)
Semimanufactures		558	691
Iron and steel:			
Iron ore[2]	thousand tons	21,821	22,990
Iron ore concentrate	do.	975	414
Scrap	do.	126	218
Pig iron, shot, pellets	do.	210	856
Ferroalloys:			
Ferrochrome		3,115	4,823
Ferromanganese		2,001	24,154
Ferrosilicon		--	8,316
Steel ingots and equivalent primary forms	thousand tons	118	298
Semimanufactures:			
Bars, rods, angles, shapes, sections	do.	143	948
Plates and sheets	do.	2	15
Hoop and strip	do.	(1)	(1)
Rails and accessories	do.	(1)	77
Wire	do.	2	3
Pipes, tubes, fittings	do.	99	230
Castings and forgings, rough	do.	7	6
Lead:			
Oxides		187	23
Metal and alloys, all forms		38	170
Manganese ore and concentrate:			
First-grade ore		81,983	29,812
Second-grade ore		196,826	222,270
Ferruginous manganese ore[3]		514,530	462,356
Manganese oxide		584	24
Other		20	--
Nickel metal including alloys, all forms		13	5
Selenium, elemental	kilograms	--	(1)
Silicon, elemental	do.	3,668	--
Silver metal including alloys	thousand troy ounces	42,323	40,875
Tin metal including alloys, all forms		4	27

See footnotes at end of table.

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Table 2.—India: Exports and reexports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS —Continued		
Titanium ore and concentrate:		
Ilmenite ore	68,975	120,727
Other	1,300	300
Tungsten metal, all forms kilograms	133	7
Zinc:		
Oxide	55	235
Metal including alloys, all forms	537	9
Other:		
Ores and concentrates:		
Of rare-earth metals	310	--
Of vanadium, molybdenum, columbium, tantalum, zirconium	2,510	--
Oxides and hydroxides, n.e.s	158	300
Metal-bearing residues	268	458
Base metals including alloys, all forms, n.e.s	--	57
NONMETALS		
Abrasives:		
Natural emery, crude	96	32
Natural, n.e.s	5	117
Natural or synthetic dust and powder of gem stones, except diamond	--	220
Abrasive wheels, stones, powder	1,026	2,122
Asbestos	38	49
Barite and witherite	173,610	151,426
Boron materials: Boric acid	117	146
Cement, hydraulic	338,055	619,728
Chalk and clay products (including all refractory brick):		
Crude:		
Ball clay	73	--
Bentonite	9,665	12,631
Earth clay	280	(1)
Fire clay	940	266
Fuller's earth	110	21
Kaolin	1,818	3,778
Other, n.e.s	404	889
Products:		
Refractory (including nonclay refractory products)	14,065	16,681
Nonrefractory	[4]931	[4]16,599
Diamond, gem:		
Uncut value, thousands	[r]$462	$109
Cut do	[r]$101,785	$209,303
Feldspar	6,509	11,983
Fertilizer materials: Ammonia, anhydrous and aqueous value	[r]$284	$2,390
Gem stones, except diamond:		
Natural:		
Uncut:		
Emerald value, thousands	[r]$768	$645
Feldspar do	[r]$4,599	$3,802
Cut do	[r]$16,881	$19,028
Synthetic and reconstituted:		
Uncut do	[r]$19	$51
Cut do	[r]$232	$1,826
Graphite, natural	50	4
Gypsum and plasters	97	974
Kyanite and related materials:		
Kyanite, calcined	7,082	5,295
Kyanite, other	16,498	6,096
Sillimanite	100	455
Other	2	26
Lime: Quicklime and hydraulic lime	1,393	5,383
Magnesite:		
Crude	35	108
Calcined, excluding dead-burned	9,339	7,790
Dead-burned	352	342
Mica:		
Crude:		
In blocks	574	889
Condenser film	126	146
Splittings	3,484	3,530
Scrap and waste	22,456	8,055
Manufactured:		
Condenser film plates	9	4
Washer disks	99	151
Cut sheets and strips	37	47
Micanite and other built-up mica	14	33
Powder	7,878	9,239
Other	3	53
Pigments, mineral:		
Natural, not further described	394	331
Iron oxide	3,696	3,215

See footnotes at end of table.

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Table 2.—India: Exports and reexports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS —Continued			
Salt		328,199	356,984
Sodium and potassium compounds, n.e.s.:			
Caustic soda		7,244	3,759
Caustic potash		119	344
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Slate		63	1,101
Marble		561	1,345
Other		53,932	150,060
Crushed stone, broken stone, gravel:			
Dolomite		3,369	5,945
Limestone for lime manufacture		121,258	219,172
Quartz		2,929	6,520
Other		467	6,520
Sand excluding metal bearing		5,898	229
Sulfur:			
Elemental		327	322
Sulfuric acid		2,466	989
Talc: Steatite and soapstone		7,157	8,785
Other:			
Crude		1,901	3,791
Slag and wastes, not metal bearing		42	622
Oxides and hydroxides of strontium, barium, and magnesium		58	370
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		45,693	17,195
Carbon black		1,792	3,306
Coal:			
Bituminous		417,279	470,220
Other		7,817	7,308
Coke		15,389	24,313
Petroleum refinery products:			
Gasoline	thousand 42-gallon barrels	14	NA
Kerosine and jet fuel	do	105	NA
Distillate fuel oil	do	122	NA
Residual fuel oil	do	--	NA
Lubricants	do	69	NA
Other	do	975	NA
Total	do	1,285	(5)
Crude chemicals produced from the distillation of coal, oil, and/or natural gas		69,316	1,305

[r]Revised NA Not available.
[1]Less than 1/2 unit.
[2]Includes manganiferous iron ore containing up to 10% Mn.
[3]Grade: 10%-30% Mn.
[4]Partial figure; excludes materials not reported quantitatively valued at $76,990 (revised) in 1975 and $89,440 in 1976.
[5]Official trade statistics do not report petroleum refinery products under categories used above. Instead, all products are listed in three categories, as follows, with quantities given in metric tons: 1975—light distillates 26,003; medium distillates, 77,578; and other, 40,980; and 1976—light distillates 28,666; medium distillates 52,778; and other 65,046.

Table 3.—India: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS			
Aluminum:			
Alumina		491	361
Metal and alloys, all forms		8,577	2,029
Antimony:			
Ore and concentrate, gross weight		723	1,523
Oxides		39	45
Metal and alloys, all forms		11	46
Arsenic:			
Crude sulfides		2	8
Oxides and acid		484	836
Elemental		15	22
Beryllium metal and alloys, all forms	kilograms	1,232	615
Bismuth metal and alloys, all forms		1	2
Cadmium metal and alloys, all forms		6	(1)

See footnotes at end of table.

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Table 3.—India: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS —Continued			
Chromium:			
Oxide and hydroxide	kilograms	5	400
Metal and alloys, all forms		50	61
Cobalt:			
Oxide and hydroxide		6	7
Metal and alloys, all forms		110	59
Copper:			
Ore and concentrate		25,368	--
Metal including alloys:			
Scrap		1,138	7,113
Unwrought		17,639	31,185
Semimanufactures		3,437	2,515
Iron and steel:			
Iron ore		--	178
Roasted pyrite		--	3
Metal:			
Scrap		15,714	28,135
Pig iron, sponge iron, iron and steel powder		492	535
Ferroalloys		865	794
Steel ingots and equivalent primary forms		25,073	12,372
Semimanufactures:			
Bars, rods, angles, shapes, sections		108,845	58,688
Sheets and plates		469,477	255,956
Hoop and strip		25,689	15,452
Rails and accessories		r9	25
Wire		4,267	2,679
Pipes, tubes, fittings		81,817	88,026
Castings and forgings, rough		10,120	5,859
Lead:			
Ore and concentrate		30	145
Oxide		r40	18
Metal:			
Unwrought		21,340	46,144
Semimanufactures		171	235
Magnesium metal and alloys, all forms		256	296
Manganese:			
Ore and concentrate		5,430	190
Oxides		22	38
Metal and alloys		112	87
Mercury	76-pound flasks	7,016	9,531
Nickel:			
Matte		(1)	--
Metal including alloys:			
Scrap		221	852
Unwrought		3,144	2,792
Semimanufactures		1,868	1,731
Platinum and silver:			
Waste and scrap		8	12
Platinum metal, unwrought and semimanufactures	troy ounces	17,079	18,022
Silver metal, unwrought and semimanufactures	do	21,561	56,814
Rare-earth metals, ore and concentrate		--	15
Selenium, elemental		7	2
Silicon, elemental		1,119	605
Tantalum metal and alloys, all forms	kilograms	825	180
Tin:			
Oxide		10	11
Metal and alloys:			
Scrap		2,025	4,127
Unwrought		2,316	3,111
Semimanufactures		3	3
Titanium oxide		r2,573	4,068
Tungsten:			
Ore and concentrate		216	500
Metal, all forms		59	34
Zinc:			
Ore and concentrate		23,079	38,493
Oxide		--	11
Dust		1,126	590
Metal and alloys:			
Unwrought		37,982	47,829
Semimanufactures		59	688
Other:			
Ores and concentrates of vanadium, molybdenum, columbium, tantalum, zirconium		37	90
Scrap and other wastes, n.e.s		3	1
Metalloids, n.e.s		35	23
Metals, unwrought and semimanufactures, n.e.s		64	328
NONMETALS			
Abrasives:			
Tripoli earths		18	2

See footnotes at end of table.

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Table 3.—India: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976
NONMETALS —Continued		
Abrasives —Continued		
Other natural	--	2
Dust and powder of natural or synthetic gem stones, except diamond ----- kilograms	83	546
Grinding and polishing wheels and stones	730	464
Asbestos	41,515	47,167
Boron materials:		
Crude natural	15,929	11,498
Boric acid	[2]30	3
Bromine, elemental	--	230
Cement	--	702
Clays and clay products (including all refractory brick):		
Crude clays:		
Ball clay	721	465
Bentonite	7	17
Earth clay	279	1
Fire clay	--	186
Fuller's earth	143	231
Kaolin	10	5
Other	397	103
Clay products:		
Nonrefractory	[3]17	249
Refractory	4,547	10,903
Diamond:		
Gem ----- value, thousands	[r]$82,962	$156,252
Industrial ----- thousand carats	795	480
Diatomite (kieselguhr and infusorial earths)	1,391	1,251
Fertilizer materials:		
Crude, natural: Phosphate rock ----- thousand tons	567	472
Manufactured:		
Nitrogenous:[4]		
Ammonium nitrate, ammonium sulfate, and urea, N content ----- do	1,375	974
Other, gross weight	425,837	43,220
Phosphatic	65,548	5,028
Potassic	311,350	258,876
Mixed	705,834	30,894
Fluorspar, cryolite and chiolite	4,206	5,062
Gem stones (except diamond):		
Natural, uncut:		
Emerald ----- value thousands	[r]$4,876	$6,698
Feldspar ----- do	[r]$7	$120
Other ----- do	[r]$545	$445
Synthetic and reconstituted, uncut ----- do	[r]$89	$65
Graphite, natural	404	647
Gypsum and plasters	8	45
Iodine, elemental (except colloidal)	340	97
Lime: Quicklime and hydrated lime	--	9
Magnesite, crude	21	--
Mica, worked	81	30
Pigments, mineral:		
Iron oxide	928	1,063
Other	252	152
Pyrite, gross weight	--	6
Salt	399	252
Sodium and potassium compounds, n.e.s.:		
Caustic soda	([1])	50
Caustic potash, potassium, sodium peroxide	5	196
Stone, sand and gravel:		
Dimension stone:		
Crude and partly worked	33	[5]66
Worked ----- value	--	$1,111
Dolomite, chiefly refractory grade	--	2
Gravel and crushed stone:		
Quartz ----- value	$25,678	$30,275
Other	1	8
Sand, excluding metal bearing	[6]11	--
Sulfur:		
Elemental	617,074	588,741
Sulfuric acid	9	([1])
Talc: Steatite, soapstone, pyrophyllite	17	11
Other:		
Crude nonmetal ores	9,143	9,717
Slag and ash, not metal bearing	--	28
Oxides and hydroxides of barium, strontium, and magnesium	101	107
Fluorine and colloidal iodine	11	2
Building materials of asphalt, asbestos and fiber cement, and unfired nonmetals, n.e.s	407	1,144
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	523	281

See footnotes at end of table.

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Table 3.—India: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Carbon black and gas carbon:			
Carbon black		1,291	1,094
Gas carbon		3	5
Coal, anthracite		2,485	35
Coke, all types		75	--
Petroleum:			
Crude oil	thousand 42-gallon barrels	100,918	98,753
Refinery products:			
Gasoline	do.	332	--
Kerosine and jet fuel	do.	5,092	5,324
Distillate fuel oil	do.	4,267	4,304
Residual fuel oil	do.	5,548	5,495
Lubricants	do.	553	350
Other	do.	--	1,340
Total	do.	15,792	16,813
Crude chemicals derived from the distillation of coal, oil, and/or natural gas		11,832	3,294

ʳRevised.
[1]Less than 1/2 unit.
[2]Revised from none.
[3]Excludes quantity valued at $3,525.
[4]Some nitrogenous fertilizers are reported in terms of contained nitrogen, others in terms of gross weight, thus they cannot be added.
[5]Excludes quantity valued at $170.
[6]Excludes quantity valued at $282.

COMMODITY REVIEW

METALS

Bauxite, Alumina, and Aluminum.—Bauxite production, strongly dependent on the slumping aluminum industry, was basically unchanged from the previous year and totaled 1.5 million tons valued at $4.8 million in 1977. Nearly 90% of the production came from the States of Bihar, Madhya Pradesh, Maharashtra, and Gujarat. This pattern could change radically, however, in the early 1980's because of recent discoveries of rich bauxite deposits along the Andhra Pradesh and Orissa coasts.[9]

Based on the exploration by the Mineral Exploration Corp. (MEC) and the GSI, the east coast deposits were estimated to be some of the world's largest, about 1,250 million tons in Orissa and 750 million in Andhra Pradesh, based on cutoff grade of 40% Al_2O_3 and less than 5% SiO_2. About 700 million tons was already classed as proven. The bauxite is well suited for metallurgical use, being low in silica and titanium and high in gibbsite.

Reserves in the other States remain unchanged at about 400 million tons, bringing the country's total to about 2,400 million tons. India ranked fourth in the world in bauxite reserves.

Domestic consumption of bauxite during 1977 was just over 1 million tons, a slight decrease from that of 1976. In view of the continuing electric power shortage, production and consumption may be expected to increase only a small amount during 1978. Other bauxite consumers were the chemical, refractory, abrasive, cement, and steel industries.

A small amount of bauxite was exported to Spain and Abu Dhabi. According to the Government's current policy, low-grade bauxite was freely exportable but only limited amounts of high-grade bauxite exports (more than 50% Al_2O_3 and less than 5% SiO_2) were permitted. With development of the east coast deposits, this policy will no doubt be modified.

The major highlight in the alumina sector during 1977 was India's commissioning of two feasibility studies for establishing export-oriented alumina plants based on the rich, east coast bauxite discoveries.

An agreement with Pechiney Ugine Kuhlmann (PUK) of France called for an economic feasibility study for establishing a bauxite mine, a 600,000- to 800,000-ton-per-year alumina plant, a 160,000-ton-per-year smelter, a caustic soda plant, and downstream chlorine utilization facilities. Tentative location would be in Koraput district in southern Orissa State. Costs were estimated at $1.5 billion and would climb another $350

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million with the construction of a 300-megawatt-capacity powerplant to support the smelter operation. Subject to Government approval of its feasibility study and arrangement of external financing, the first alumina could be produced during 1983.

The Soviets were also beginning a feasibility study for a 600,000-ton-per-year alumina plant based on the Andhra Pradesh deposits. Estimated cost of this project was $470 million. The Soviets would import between 300,000 and 400,000 tons per year, leaving the balance for sale to other countries. There were no plans to convert alumina from this project into aluminum. The final studies were expected by March 1979.

The Government signed an agreement with Hungary to set up a 300,000-ton-per-year alumina plant in Kutch district in Gujarat.

The State-owned Bharat Aluminum Co. Ltd. (BALCO) was the only company producing bauxite for both export and local consumption. However, the private company Indian Aluminum Co. Ltd. (INDAL) planned to expand its production at the Belgaum plant in Karnataka by 140,000 tons per year of alumina to feed Iran's Irak smelter, which was being expanded. The plans were not firm, but INDAL's relatively low costs and proximity to Iran appear to give the company an export advantage.

The severe electric power shortages during the year probably affected the aluminum industry more than any other mineral-related sector.

The electric-power-intensive aluminum smelters were consistently the plants subject to power cutbacks and outages. As a result, production declined sharply to 184,000 tons in 1977 from a record high of 212,000 tons in 1976. The installed capacity of India's five aluminum companies was over 275,000 tons per year, but utilization averaged only 67% during the year.

Aluminum metal production and yearend capacity, by plant, in tons, and utilization rate, in percent, in 1977 were as follows:

Company and plant location	Capacity	Production	Utilization rate
Private sector:			
Aluminium Corp. of India:			
Asansol, West Bengal	9,000	[1]	--
Hindustan Aluminium Corp. Ltd:			
Renukoot, Uttar Pradesh	100,000	73,119	77.0
Indian Aluminium Co.:			
Alwaye, Kerala	15,850		
Belgaum, Karnataka	60,000	65,609	68.2
Hirakud, Orissa	20,320		
Madras Aluminium Corp. Ltd.:			
Mettur, Tamil Nadu	25,000	16,745	67.0
Public sector:			
Bharat Aluminium Corp., Ltd.:			
Korba, Madhya Pradesh	50,000	28,381	56.8
Total	280,170	183,854	66.8

[1]Metal production ceased in September 1973.

Reportedly, the Government was considering the nationalization of Hindustan Aluminium Corp. Ltd. (HINDALCO), based on the recommendations of the Uttar Pradesh State government. Kaiser Aluminum and Chemical Corp. had a 27% ownership in HINDALCO, and the remainder was held by Birla and other Indian interests.

During 1977, BALCO finally commissioned its second 25,000-ton-per-year potline, bringing its total to 50,000 tons per year. The commissioning of a third potline of equal capacity awaited availability of electric power, and construction on a fourth potline neared completion at yearend. BALCO's FY 1978 production target of 74,000 tons did not appear feasible in view of the power problems.

Development plans called for increasing total capacity by the 50,000 tons per year under construction by BALCO and 25,000 tons per year by HINDALCO, also awaiting commission when power is available. This would bring India's total capacity to 350,000 tons per year. These increases and the efficient use of existing smelters can be achieved only if the Government's plans to increase India's total power capacity from 25,000 to 45,000 megawatts are carried out on schedule. Power projects have frequently missed planned startup dates in the past.

In order to meet the aluminum shortfall of about 16,000 tons in 1977, about 5,000 tons was imported at a cost of $4.9 million. The balance was made up from secondary metal. Imports, however, were likely to increase to about 20,000 tons in 1978.

Chromium.[10]—India's chromite produc-

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tion was over 350,000 tons valued at nearly $20 million in 1977, down from 402,000 tons valued at $23 million in 1976. The decline was largely attributed to an inadequate domestic demand and the worldwide recession in the steel industry. Nearly 97% of the production came from Orissa.

Nearly 80% of the consumption is accounted for by the metallurgical and refractory industry, and 20%, by the chemical industry. Demand was estimated at 120,000 tons. Based on the proposed steel development program, India's total consumption was expected to be 150,000 to 160,000 tons by FY 1982, which would leave a sizable surplus for possible export.

Exports were 278,000 tons in 1976 valued at $31 million and were reported to be 117,000 tons for 1977. The depressed nature of the international market for chromite, particularly the reduced imports by Japan, has been a major factor affecting sales abroad.

Concerned about India's limited reserves, the Government banned the export of high-grade chromite, and exports of lower grades are subject to a quota system. A graded duty was recently imposed as a further step to conserve these resources.

Imports, the only source of chromium metal, amounted to 61 tons valued at over $400,000 in 1977. Since there were no plans for the domestic production of this metal, imports were expected to continue indefinitely.

Chromite reserves were officially put at over 17 million tons of all classes, with Orissa accounting for nearly three-fourths of the total. Exploratory work was underway by GSI to establish additional reserves. Exploration at Byrapur, Hassan district, Karnataka, indicated considerable potential for increasing the reserves. Based on preliminary results, the country's total reserves could be as high as 50 million tons.

Copper.—The Government-owned Hindustan Copper Ltd. (HCL) was organized in 1967 and charged with the responsibility of developing and exploiting the copper deposits in India and minimizing the country's dependence on foreign sources. HCL was given sole control of the copper industry when the privately owned Indian Copper Corp. Ltd. was taken over and incorporated into HCL in 1972.

The HCL mines in Rajasthan and Bihar continued to account for the major share of India's copper ore production; a small share came from Karnataka. Nearly 2.6 million tons were mined during 1977, over 7% more than in the previous year. The principal producing mines were Rakha Mosoboni, Pathargora, Surda, and Kendadih in Bihar; and Khetri, Kolihan, Chandmari, and Dariba in Rajasthan.

The ore production capacity at Khetri was designed for 3,000 tons per day, but production was actually averaging about 2,500 tons per day. This was to be stepped up to 4,000 tons per day by fiscal 1980. Kolihan mine production was about 1,600 tons per day and was to be increased to 2,000 tons per day. Chandmari, the only open pit operation at Khetri complex, produced about 500 tons per day and was scheduled for doubling to 1,000 tons per day by around FY 1981. The small Dariba mine produced about 100 tons per day. It will be difficult to attain the goals for ore production in view of the yearend FY 1977 labor problems and the continuing electric power shortages.

India's entire copper production came from HCL's two smelters, which have a combined capacity of 57,000 tons per day. They were located at Ghatsila in Bihar and Khetri in Rajasthan and supplied about 42% of India's annual requirements of 55,000 tons of primary copper.

Production of blister copper totaled about 23,500 tons, down marginally from 1976. Steps were underway to increase production to over 32,000 tons in FY 1978. However, there were labor problems at the Khetri complex that were unresolved at the end of FY 1977, and the electric power shortages in Bihar and Rajasthan were particularly acute. It was, therefore, unlikely that 1978 would show a significant production increase and may in fact, show a decrease from the 1977 output.

Copper consumption in recent years varied between 50,000 and 60,000 tons, but was projected to increase to about 80,000 tons by FY 1982. Despite new copper developments being planned or underway, India's domestic production is not likely to exceed 50% of its requirements by the end of the 1978-83 plan period. The balance will be made up by imports.

Copper metal imports were off by nearly 50% to about 20,000 tons costing about $30 million in 1977. Major suppliers were Zambia, Canada, Belgium, and Zaire. In addition to the metal, about 13,000 tons of copper concentrate was also imported. Plans called for the import of at least 32,000 tons valued at about $89 million during FY 1978, but this figure could be much higher

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due to the continuing production shortfalls resulting from power shortages and technical difficulties.

Estimated at about 370 million tons in 1977, India's copper ore reserves remained small by world standards. About 90% of the country's reserves are located in Bihar, Rajasthan and Madhya Pradesh. MEC confirmed 8.2 million tons of polymetallic ore at Ambamata in Gujarat and 1 million tons at Mailaram in Andhra Pradesh. A sizable deposit of copper has reportedly been located at Tosham and Khodana in Bhiwani district in Haryana. Ongoing, detailed geochemical investigations were to determine the extent and mineralogy of the deposit.

Development and exploration activities were continued by the Government in an effort to locate new reserves and increase ore production. The most important development during the year was the approval by the Government of the Malanjkhand project in Balaghat district of Madhya Pradesh. The detailed project report was made by Soviet mining experts. The open pit operation was expected to produce 1 million tons per year of ore by FY 1981 and 2 million tons by FY 1983. A mill at the mine was to produce 100,000 tons per year of 25% copper concentrate. The concentrate will be shipped to Khetri to utilize the idle capacity at the smelter. Development costs were planned at over $100 million and will probably rise considerably higher in light of rapid cost increases. HCL planned to appoint local contractors and avoid imports of equipment as far as possible for the construction job.

Other copper deposits were explored or were being drilled to determine reserve status. In Rajasthan they were at Singhana in Jhunjhunu district, Padarkipal in Dungarpur district, Derhi and Basantgarh in Sirohi district, and Khankhera in Bharatpur district. MEC began exploratory mining operations to further evaluate the Kesarpur copper deposit in the Mayurbhanj district in Orissa. GSI had earlier completed a detailed drilling program at the site. About 1.7 million tons of chalcopyrite ore with a 0.7% copper cutoff was proved. The average grade was reportedly 1.59% copper. If the deposit can be exploited economically, a mill will be built at the site and the concentrate shipped to the Ghatsila smelter.

Iron Ore.—Iron ore production declined slightly in 1977 mainly because of lower export demand, but India remained the seventh largest producer in the world. Despite the decline in tonnage, the mine value of the ore remained steady at about $102 million. This ranked iron third behind coal and petroleum in value for all Indian minerals produced.

Nearly 60% of production came from Madhya Pradesh, Orissa, and Bihar where most of the integrated steel mills are located. Goa produced around 30% of the total, mostly for the export market. Domestic consumption remained steady at about 18 million tons. The projection for 1978 was 18.9 million tons.

According to the Government's 1978-83 plan, iron ore production was to be increased from 43 million to 65 million tons by the end of FY 1982. Most of the increase was to come from the Kiriburu mines in Orissa, the new mines at Donimalai in Karanataka, which went into production in late 1977, and the Bailadila deposit No. 5 in Madhya Pradesh, which was commissioned in early 1977. The mines were being developed by the National Mineral Development Corp. (NMDC). Other major hematite areas under development by NMDC included the Bellary-Hospet region of Karnataka, which, in addition to the Donamali mines, included the Ramandurg and Kumaraswamy deposits; Rowghat and Dallirajhara of Madhya Pradesh; and the Meghahatuburu and Malangtoli deposits of Orissa. The Meghahatuburu deposit was being developed to produce 1.3 million tons of lump ore and 3 million tons of fines per year for the Bokaro steel plant. Work had begun on the mine, but there had been little progress on the processing plant by yearend.

NMDC was also conducting feasibility studies of Bailadila deposits 11C and 13, Kumaraswamy B and D ore blocks, and Kiriburu central ore block.

There were two, private-sector pelletization plants with a combined capacity of 1.5 million tons per year in operation, one in Goa and one at Noamundi in Bihar. A third plant, of 1.8 million tons per year capacity, was under construction in Goa. The plant was designed by the West German firm Lurgi and owned jointly by the Steel Authority of India, Ltd. (SHIL), and Chowgule & Co. Pvt. Ltd. The plant is scheduled to start operations in early 1979 and supply pellets to Japan under a 10- to 12-year contract beginning in 1980.

Exports for FY 1977 declined by 1.3 million tons to 21.8 million largely because of a

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cutback of Japanese steel production. Although the volume declined, the value rose to $295 million from $280 million in 1976. Japan accounted for about three-fourths of the exports. The Minerals and Metals Trading Corp. (MMTC), which handled all exports except the Goa material, initiated steps to explore new markets. A trial shipment of 20,000 tons was made to Iraq. A contract for the supply of 20,000 to 30,000 tons was signed with the Peoples Republic of China. Negotiations were also going on with Pakistan, Bulgaria, and Romania for further export orders. The export target for FY 1982 was 40 million tons, including 7.5 million tons of magnetite concentrates to Iran from the Kudremukh project. Kudremukh will supply a total of 150 million tons of pellet feed over a 20-year period. Progress on the $630 million Kudremukh construction was about on schedule at year-end. Canadian Met-Chem Consultants Ltd., a subsidiary of United States Steel Corp., was the foreign consultant on the project. The firm was in charge of design, engineering, procurement, and supervision of construction, and also will manage the project for 3 years after completion.

India's iron ore reserves continued to increase as detailed exploration work progressed around the country. The total of all grades and types was estimated to be over 17 billion tons but may be a great deal higher. Proved reserves of hematite were over 6.6 billion tons of +62% iron ore. The Chiria deposit of 1.97 billion tons in Bihar was the largest hematite ore body in India.

The largest magnetite deposit was in the Bababudan hills of Karnataka where inferred reserves were 3 billion tons of banded magnetite-quartzite ore with a 30% iron content. Preliminary drilling indicated a workable ore body of 1.5 billion tons and very little overburden. The iron content of economic Indian hematite ranges from 62% to 65% compared with 26% to 35% for magnetite. India's iron ore resources, by State and type of ore, were as follows, in million tons of ore:

Type of ore and State	Measured	Indicated	Inferred	Total
Hematite:				
Bihar	2,635	80	509	3,224
Goa	100	119	192	411
Karnataka	518	208	492	1,218
Madhya Pradesh	1,439	1,044	553	3,036
Maharashtra	101	94	36	231
Orissa	1,825	361	823	3,009
Rajasthan	1	--	12	13
Total	6,619	1,906	2,617	11,142
Magnetite:				
Andhra Pradesh	--	--	105	105
Karnataka	610	--	4,554	5,164
Kerala	--	--	96	96
Tamil Nadu	107	--	539	646
Total	717	--	5,294	6,011
Grand total	7,336	1,906	7,911	17,153

Iron and Steel.—In contrast to the steel supply surplus of the past 3 years, India showed a short supply and a steady rise in the prices of steel by the end of FY 1977. A large expenditure on construction of various development projects in the past year spurred a 14% rise in domestic steel demand. However, crude steel production in three of the six integrated steel plants declined in FY 1977. Shortages of electric power and coal and labor unrest reduced the annual average rate of capacity utilization by the integrated mills to 89.5% from 1976's record level of 92%. Total crude steel production advanced only 1%, the smallest rate in 4 years. The increase in domestic demand and shortfalls in production in some of the mills eliminated the excess supply of steel. Steel shortages induced the Government to curb exports and relax some import controls in FY 1977. India, however, retained its previous year's position as a net exporter of steel. Prices rose between 10% and 30% during 1977, depending on the type of steel.

The Government, despite its bias for rural development, recognized the need for expansion of the indigenous steel production capacity. However, lack of funds and the increasing costs of new plants restricted rapid expansion of the steel industry.

Production.—Preliminary official esti-

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mates show that India produced 9.8 million tons of steel ingots in FY 1977, a 1% increase over FY 1976. This was the smallest growth in the past 4 years and a sharp decrease from the record 23% growth rate of FY 1976. Similarly, total finished steel production in FY 1977 rose to 6.98 million tons from 6.90 million tons in 1976. Pig iron production declined 5% to 9.5 million tons, reversing the upward trend of 1976, when production increased 20%.[11]

The stagnation of steel production resulted from lost output at three of the public-sector plants—Bokaro, Rourkela, and Indian Iron and Steel Co. It was estimated that electric power shortages caused a direct loss of 100,000 tons of ingot production. Shortages and the poor quality of coking coal led to further production problems.

In contrast to the shortfalls of the public-sector plants, the Tata Iron and Steel Co., the oldest mill in India and the only privately owned, integrated mill in the country, produced 6% more than its rated installed capacity. The overall capacity utilization of the integrated mills dropped to 89.5% from the peak of 92%. In addition to the power and coal problems, labor troubles contributed to the lowered efficiency in industry. Coal stocks on hand at the mills decreased during the year, and by yearend, it appeared that some mills would suffer production losses in 1978 if the coal situation did not improve markedly.

The secondary producers and the steel minimills in the private sector also did well and increased crude steel production by 12% to 1.2 million tons in 1977. The shortages of the integrated plants will give the steel miniplants a chance to increase production further in 1978. Total capacity of the 400 miniplants was over 4 million tons per year, but only about 120 of the plants were operating during 1977, most of them at well below capacity. Average capacity utilization, however, increased from 44% in May 1977 to 60% by the end of FY 1977.

Official production targets for the integrated mills for FY 1978 called for a 16% increase in steel ingots and 10% increase in salable steel. The outlook, however, was not promising because power and coal shortages were continuing at yearend. The target for the steel minimills called for a substantial increase of over 30%. In January 1978, to encourage output, the Government permitted the electric furnace units to arrange direct, tariff-free imports of ferrous scrap, to a limit of 200,000 tons each. The successful increase in the steel minimills' production will depend very heavily on whether adequate electric power can be obtained and whether they are permitted to diversify their production from mild steel to alloy and special steels.

Exports and Imports.—With the rise in domestic demand, steel export earnings were down about one-third to $268 million from the sale of 1.8 million tons in FY 1977. Most of the steel went to the Middle East countries. Pig iron, bars and rods, billets, and structurals were the main items of export. Because of the substantial rise in the domestic demand, the export target for FY 1978 was revised downward to 800,000 tons valued at roughly $117 million. Even that figure may prove to be high, and a more realistic figure would be in the 500,000- to 600,000-ton range.

Steel imports were estimated at 350,000 tons valued at $139 million in FY 1977, a slight increase over that of 1976. Imports for FY 1978 were projected at 500,000 to 600,000 tons, consisting of cold-rolled sheets, plates, structurals, and tinplate. Steel imports were expected to continue for several years at about 500,000 tons annually, despite projected increases in production, because it was uneconomical to produce certain low-volume products. Also, certain highly specialized steels and alloys were not available domestically.

Development and Expansion.—The 1978-83 plan called for an increase in steel production from 9.8 million tons in FY 1977 to 15 million in FY 1982. The largest recipient of investment funds in the industry and minerals sector was steel, with an allocation of about $2.93 billion, mostly for ongoing projects. Increased investment costs and lack of funds restricted the rapid expansion of the steel industry. Major programs already approved were as follows:

The Bhilai Steel Plant was expanded from 2.5 million tons to 4 million tons to produce additional amounts of heavy plates and billets. The U.S.S.R. will supply continuous casting equipment for a 3.6-meter-heavy-plate mill complex. The overall expansion costs at Bhilai have inflated to at least $1.3 billion. Most of the new equipment was to be completed by December 1981, but the seventh blast furnace was scheduled for June 1983 commissioning.

Bokaro Steel Ltd. completed its first phase construction with assistance from the U.S.S.R. An annual capacity of 1.7 million tons of crude steel was achieved when

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the first cold-rolling mill and the third blast furnace were commissioned in June 1977 and February 1978, respectively. The expansion from 1.7 million to 4.0 million tons per year by 1980 was underway at an investment cost inflated to $1.26 billion. The second cold-rolling mill alone was to cost $350 million. Metallurgical and Engineering Consultants (India) Ltd. and Engineering Projects India Ltd., both Government-owned, took over the expansion project at Bokaro from the U.S.S.R. and enlisted assistance and licensing from a U.S. firm for technology, design, and equipment.

The only major new plant in the 5-year plan was the Salem steel plant in Tamil Nadu. Construction of the 32,000-ton-per-year first phase began in 1977 at a cost of $150 million. The budget allocation for FY 1978 was about $12 million. After completion of the second phase of construction, the planned annual capacity was to be 70,000 tons of cold-rolled stainless steel, 75,000 tons of electrical steel, and 75,000 tons of low-alloy, special steels. Total cost was estimated at $660 million.

The Rourkela steel plant was installing a cold-rolling mill for completion in FY 1981 and also planned to modernize its 18-year-old hot strip mill.

The Durgapur plants were scheduled for modernization and expansion and the old Indian Iron and Steel Co. facility, a chronic money loser, was scheduled to be extensively rehabilitated by the replacement of badly out-of-date machinery and equipment.

Plans for three export-oriented coastal steel plants have progressed slowly because of the high costs involved. Negotiations, however, were continuing with the Soviets for the initial establishment of the first plant, a blast furnace at Visakhapatnam to produce pig iron for export to the U.S.S.R.

A 30,000-ton-per-year sponge iron demonstration plant, partially financed by the United Nations Development Program, was being constructed at Kothagudam in Andhra Pradesh at a cost of $13.5 million. The Lurgi Co. of the Federal Republic of Germany was providing the technical assistance and equipment. The Indian Government authorized the plant in an effort to develop a suitable, economical process for direct reduction of iron ore utilizing the country's abundant, high-ash, noncoking coal as the reductant.

Construction of a second sponge iron plant was also expected to begin soon, in northern Orissa. The plant will produce 150,000 tons per year and will be based on different technology and equipment supplied by Allis Chalmers Co. (United States). Estimated cost was $28 million.

Lead.—India's domestic demand for primary lead was roughly 50,000 tons per year and was expected to increase gradually to 60,000 tons by 1982 and 80,000 tons by 1987. Production was over 7,600 tons in 1977, valued at about $6 million at 1976 prices. That was an increase of more than 40% over the previous year. Output was targeted for a substantial increase in 1978 and a further increase to 15,000 in 1982. In the face of the shortage of about 45,000 tons per year, lead imports will continue.

Lead was smelted at the Hindustan Zinc Ltd.'s (HZL) 8,000-ton-per-year plant at Tundoo in Bihar. A second smelter was under construction at Visakhapatnam in Andhra Pradesh, which will have a 10,000 ton-per-year capacity at its scheduled completion in June 1979. The Tundoo plant was fed by concentrates produced at the HZL's Zawar mines in Rajasthan, and the Visakhapatnam smelter was to operate on imported concentrate.

Production of lead concentrates was estimated at 16,700 tons in 1977, up marginally from 1976. Nearly 90% of the production was from HZL's Zawar and the remainder from HCL's mines in Agnigundala in Andhra Pradesh. With further development of the lead-zinc mines in Rajasthan, the production of lead concentrates should improve significantly. Plans called for an increase in ore production from 100 tons per day to 240 tons per day at Agnigundala. A small concentrator at Agnigundala produced 70% lead concentrate, which was shipped to Tundoo for smelting.

During 1977, imports were estimated at over 51,000 tons compared with 46,000 in 1976 and more than 21,000 in 1975. Anticipating higher production in 1978, lead imports were projected at 40,000 tons valued at about $36 million.

Manganese.—India's manganese ore production remained about 1.8 million tons in 1977. Orissa, Karnataka, Madhya Pradesh, and Maharashtra accounted for nearly all of the production. The public-sector, Manganese Ore (India) Ltd., operated the majority of the high-grade deposits and produced over 75% of the country's high-grade ore and 25% of the total production.

The lower grades of manganese ore are used directly in the steel industry, while the higher grades were used for ferroman-

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ganese production. Since 1971, the country's manganese ore consumption has almost doubled, reaching 826,000 tons in FY 1976. Because of the projected 50% increase in India's steel production during the current plan period, consumption of manganese ore was projected to rise to about 1.4 million tons by yearend 1982.

Since 1974, India's manganese exports have steadily declined, although the earnings have remained relatively stable due to price increases. Exports in 1977 were about 550,000 tons compared with 714,000 in 1976. In view of the anticipated rise in domestic requirements and limited reserves, an export ban was levied on high-grade ore and a ceiling on low-grade. A small amount of specially processed high-grade ore was imported for dry-cell production.

To eliminate the imports and better utilize the domestic reserves, a 1,000-ton-per-year electrolytic manganese dioxide plant began commercial production in 1977 in Trevandrum in southern Kerala. The process technology was developed by the National Metallurgical Laboratory at Jamshedpur.

There was some controversy as to the total reserves of manganese in India. The Indian Bureau of Mines reported 108 million tons of all grades. Other reports put the figure as low as 79 million tons. In any case, the Indian Government was concerned with the rapid depletion of the strategically vital and valuable mineral resource. The GSI recently reported a new discovery of up to 10 million tons in Bastar district of Madhya Pradesh.

To formulate a long-term policy for export and internal consumption, a detailed investigation of manganese resources was begun. The Government also initiated a program for the optimum utilization of manganese reserves through beneficiation of low-grade ores, dephosphorization of high phosphorous ore, and the use of fines and rejects.

Nickel.—India met the major share of its nickel requirements through imports from the United Kingdom, Australia, and Finland. Imports totaled over 5,500 tons valued at nearly $26 million, a 23% increase in tonnage over those of 1976. Demand was expected to increase during the early 1980's with the scheduled commissioning of the Salem special steel plant in Tamil Nadu.

The only domestic source was the copper smelter at Khetri where nickel sulfate was recovered as a byproduct. Recovery was about 150 tons in 1977, and the target for 1978 was 180 tons. Prospects for increasing the domestic byproduct recovery were good in view of the planned production increases for domestic copper.

The country's nickel ore reserves were put at about 100 million tons. About 69 million tons averaging 0.85% nickel was located in the Sukinda area of Cuttack district in Orissa. Based on a deposit averaging 1.1% nickel in the Kansa block of Cuttack, the Government proposed to set up a nickel plant at an estimated cost of $100 million. The project called for the production of 4,800 tons of nickel, 200 tons of cobalt, and 17,000 tons of byproduct ammonium sulfate fertilizer. The U.S.S.R. and Cuba offered to undertake a feasibility study concerning this Sukinda plant. Several foreign firms had earlier expressed interest in this deposit. The lateritic ore reportedly will be difficult and expensive to concentrate and refine, a problem which may jeopardize the economic viability of the project. About $1 million had already been spent on preliminary work and the FY 1978 budget provided a small allocation for the feasibility study. A new nickel deposit was identified during the year in the Mayurbhanj district of Orissa. Exploration drilling indicated over 17 million tons at a cutoff grade of 0.79% nickel.

Zinc.[12]—India relied primarily on imports to meet its domestic requirements for primary zinc metal, which are estimated at 100,000 tons in FY 1977. Major consumers were the Rourkela steel plant, the brass industry, die casting, and dry batteries. HZL met about 36% of the country's total demand in 1977 but was expected to increase its share to 50% in 1978 and to about 60% by 1982. Nevertheless, a sizable gap between supply and demand was expected to remain since consumption was expected to reach 130,000 tons by 1982 and 170,000 tons by 1987.

Imports in 1977 reportedly reached more than 63,000 tons compared with 1976 imports of 20,000 tons. A more liberal import policy and the high cost of Indian production compared with the world market price contributed to the large rise in imports. Zinc imports for 1978 were projected at 45,000 tons. Production and market conditions in 1977 indicated that India will continue to rely on imports of zinc metal and concentrates for an indefinite period.

Zinc production was confined to HZL's two smelters, one at Dariba in Rajasthan

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(45,000 tons per year capacity) and the second at Visakhapatnam in Andhra Pradesh (30,000 tons per year capacity), plus the 20,000-ton-per-year, private-sector plant at Alwaye in Kerala, operated by Cominco Binani Zinc Ltd.

Domestic zinc production has climbed steadily since 1973 when production was 12,500 tons. It reached 36,000 tons in 1977, with an estimated value of $41 million. Although production was one-third higher than in 1976, it was still considerably below the total 95,000-ton smelter capacity. Production would have been higher at the Dariba plant but electric power shortages caused an estimated 15% loss of production in 1977. HZL plans called for raising zinc production to 62,000 tons in FY 1978, and 75,000 tons by FY 1982.

Both the Visakhapatnam and Kerala plants operated on imported concentrates. As additional zinc mines come into production in Rajasthan, the Visak plant will begin to use domestic concentrates. In 1977, the Dariba smelter depended on ore supplied by the nearby Mochia and Balaria mines of the Zawar group in Rajasthan. Production of zinc concentrate in 1977 amounted to 46,000 tons, marginally higher than in 1976.

Ore production rose nearly 15% to 916,000 tons in 1977, possibly indicating some reduction in ore grade reaching the concentrator or stockpiling at the mine site. Average ore grade was reported to run 3.4% zinc and 1.2% lead. Projected ore production in FY 1978 was 1,180,000 tons.

Development of the Rajpura-Dariba mine with a planned 3,000-ton-per-day capacity was continuing. The main shaft reached the 100-meter level during 1977. The final depth was to be 550 meters, and the mine production was scheduled to yield 40,000 tons per year of zinc content, 13,000 tons of lead content, and about 13,000 kilograms of by-product silver. Two other mine developments were called for by FY 1984 to feed HZL's smelters. These were the Zawarmala mines, which were being designed for an annual ore production of 450,000 tons by FY 1982, and the Baroi mine was expected to reach the same output by FY 1984. HZL claimed that completion of these mines would eliminate the need to use imported concentrates at the Visalkhapatnam smelter.

India's zinc and lead reserves of all classes were estimated at 121 million tons, of which nearly 97 million was located at the Zawar group of mines and the Rajpura-Dariba belt of Rajasthan. Proved ore in the Zawar group was 21 million tons grading 4.2% zinc and 1.8% lead. The remaining reserves were located at Agnigundala in Andhra Pradesh (12 million tons), Ambamata in Gujarat (7 million tons), and Sargipalli in Orissa (5 million tons). Reportedly, a new lead-zinc deposit of 4 million tons of 10% combined metal content was discovered at Gorubathan in Darjeeling, district of West Bengal.

NONMETALS

Barite.—India ranked third in world production of barite, valued at the mine at nearly $2 million in 1977, about 25% more than in 1976. India's reported barite reserves in the proved category were the highest in the world.

Since domestic consumption was only about 80,000 tons per year, barite has become a major export commodity, exceeding 190,000 tons in FY 1977 valued at $14 million.[13] Although there was a decline in export tonnage in 1976, the value of foreign sales have increased each year since 1973. The principal importers were the Persian Gulf countries. Since January 1976, barite exports were channeled through the Government-owned MMTC. However, according to a new policy, the Government will permit exports through both MMTC and private exporters. A ceiling of 200,000 tons total annual exports continued, presumably with an aim to regulate foreign sales in order to realize a high unit value. Prospects continued promising in view of the country's large reserves and India's proximity to the Middle East market. Steps were underway to establish additional pulverizing units to process barite for export.

Cement and Limestone.—Although of low unit value, limestone accounted for nearly one-half of the total value of India's nonmetal mineral production during 1977. The cement and iron and steel industries were the major consumers of limestone. With the projected step-up in output of cement and steel to 30 million tons and 15 million tons, respectively, by FY 1982, total limestone consumption was expected to be around 50 million tons by the end of that year. A large deposit of metallurgical-grade limestone at Bilaspur was under development by the management of the Rourkela steel plant. Reserves at the site, which covers 10 square kilometers to a depth of 40 meters, were sufficient for several centuries of operations.

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Demand for cement continued to exceed production by nearly 2 million tons, despite a small increase in output during 1977. Overall capacity utilization of 55 units averaged about 87%. Power shortages were the major constraint to a higher output. An additional demand for cement for reconstruction purposes resulted from two severe cyclones that hit southern India.

According to the 1978-83 plan, cement production was expected to increase from 19 million to 30 million tons by the end of FY 1982. However, even operating at full capacity, imports of 1 million to 2 million tons may still be necessary. The public-sector Cement Corp. of India (CCIO) planned to establish five new cement plants with a total capacity of 2 million tons per year as part of the plan's development program.

Prompted by Government fiscal incentives and the prospects of higher demand, several private-sector companies have applied for licenses to set up new plants. Larsen & Toubro Co. planned to invest more than $115 million in a plant to be set up in two stages of 2,500 tons per day each. The plant would be located in Chandrapur district of Maharashtra. The Steel Ministry also planned to set up cement plants of 1 million tons per year capacity each at the Rourkela and Bhilai steel mills. Cement clinker was to be mixed with equal volumes of granulated slag available as waste at the two plants. Chowgule & Co. Pvt. Ltd. planned to set up a 1-million-ton-per-year cement plant at Jafrabad in Gujarat and two clinker grinding plants, one at Surat and one at Ratnagiri.

Because of the domestic shortages during 1977, cement exports were restricted to about one-quarter of the original target of 1.5 million tons. Imports during FY 1977 were over 333,000 tons from the Republic of Korea, Romania, and Poland, out of the contracted 840,000 tons. The remaining tonnage was to be delivered during FY 1978. Trade sources indicated that annual imports of 1 million to 2 million tons would be required for several years in view of the continuing shortages.

Diamond.—Domestic production of rough diamond was entirely from the Government-owned Panna Diamond Mines in Madhya Pradesh, operated by MMDC. During 1977, these mines yielded industrial and gem-quality diamonds worth about $1 million, a little less than in 1976. Plans called for the expansion of these mines with Soviet assistance.

India's small native production of diamond belies the importance of the industry in the economy of the country. India was one of the world's major cutters and polishers of gem diamond, particularly the very small stones.

Exports of diamond, including jewelry, were estimated to have increased more than 50% to a record high of at least $470 million in FY 1977; and diamond ranked fourth among India's exports. Cut and polished diamond accounted for over 80%, and other gem stones most of the remaining amount. Belgium emerged as the leading buyer, displacing the United States which held that position in FY 1976.[14] Exports to Belgium more than doubled and exports to the United States nearly doubled over the 1976 levels. Other major importers of Indian stones and jewelry included Hong Kong, Japan, the Netherlands, the Federal Republic of Germany, France, and the United Kingdom.

India's diamond industry was obviously dependent on the import of rough diamonds. These imports rose substantially to about $270 million in FY 1977. In view of the high export demand for finished stones, the import bill for FY 1978 could reach as high as $400 million. The United Kingdom and Belgium were the major sources of these stones. To improve India's competitiveness in the world market, the Government abolished the 50% import duty on rough diamonds. In addition, import policies regarding machinery and equipment required by the gem and jewelry industry were liberalized.

India's diamond industry was mainly concentrated in Gujarat with nearly 65% of diamond cutting and polishing being carried out in the city of Surat. Jaipur in Rajasthan was another important gem center. The industry employed about 200,000 persons during 1977.

Fertilizer Materials.—The Fertilizer Corp. of India (FCI), the Government-owned fertilizer producer, was reorganized into four separate companies, operating on a regional basis. The reorganization was designed to overcome the problems created by FCI's unwieldy structure. The four companies were National Fertilizers Ltd., Rashtriya Chemicals and Fertilizers Ltd., Hindustan Fertilizer Corp. Ltd., and the original parent company, FCI. The old Planning and Development Division of FCI at Sindri became a separate entity called Fertilizer (Planning and Development) India

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Limited (FPDIL). FPDIL will be the major consultant organization in the field of fertilizers and chemicals.

Total plant nutrient consumption (N, P_2O_5, and K_2O) increased over 25% in 1977 to nearly 4.3 million tons. India produced about 65% of its total needs and was forced to import the remainder at a cost of $360 million.[15] There was no production of potassium minerals for agricultural use, forcing India into total dependency on foreign supplies. The largest jump in production was in phosphate fertilizers, which rose over 40% in 1977 and more than doubled since 1975. No new production capacity came onstream during 1977, and the production increase was entirely due to better performance of existing units. Overall production in the fertilizer industry was restricted by electric power, labor, and maintenance problems.

Phosphate rock production rose to a record high in 1977. Nearly 92% of production came from India's largest deposit at Jhamarkotra near Udaipur in Rajasthan. More than 50% of the country's proved reserves were in this one deposit. Only the highest grade ore was extracted during 1977 and processed into phosphoric acid and superphosphate fertilizer. However, following detailed evaluation of the ore, it was decided that Rajasthan State Mines and Minerals Ltd. would set up a beneficiation plant at Jhamarkotra. The plant would process 1.5 to 2.0 million tons per year of ore and produce 0.75 to 1.0 million tons of marketable concentrate. The only phosphate rock concentration plant in the country, located at the nearby Maton mine, apparently doubled its capacity to 600 tons per day in 1977. The concentrate was consumed locally at HZL's byproduct fertilizer plant.

In an effort to find domestic supplies of potash, the GSI continued drilling in 1977 in the Nagaur Basin of western Rajasthan. Potash-bearing minerals were detected during the year in a 104-meter-thick halite bed at Lakhasar, Churu district. As a result, the exploration was to be intensified during 1978 by deploying two or three additional drills to test the gravity lows delineated by earlier geophysical surveys.[16]

The 1978-83 plan called for increases in nitrogeneous and phosphatic fertilizer production to 4.1 million tons and 1.1 million tons, respectively, by the end of the period. By then, estimated nitrogen (N) consumption was expected to reach 5.25 million tons, and P_2O_5 consumption, 1.6 million tons. The supply-demand gap must be filled by the continued import of costly fertilizers. Plants under construction or in final stages of planning in 1977 were to expand ammonia capacity in India by almost 2.8 million tons per year N, urea capacity by 2.2 million tons per year N, and complex fertilizer capacity by 500,000 tons per year. In addition, 180,000 tons per year P_2O_5 phosphoric acid capacity and 156,000 tons per year P_2O_5 triple superphosphate capacity was due to be commissioned in the near future.

The Indian Government abandoned plans for the construction of a large ammonia-urea complex at Mathura in Uttar Pradesh.[17] Review of the plans indicated that pollution from the proposed plant could have adverse effects on the historical monuments at nearby Agra. The lost capacity from the plants' cancellation will be made up by two new large fertilizer projects to be built in the Bombay area using offshore natural gas as feedstock.

Mica.—India's mica production continued a downward trend for the seventh consecutive year. The value at the mine was $2.6 million in 1977, a 2% decline from that of the previous year. Almost all of the production came from Bihar, Andhra Pradesh, and Rajasthan. Despite the drop in production, India accounted for nearly 70% of the sheet mica produced in the world.

The great majority of mica was graded, sorted, and split, and then exported at a considerable increase in value. Total value of exports in 1977 was about $29 million, with blocks and splittings, less than one-quarter of the total tonnage, accounting for about 83% of the sales value. The U.S.S.R. imported about 30% of the Indian mica, with the United States, United Kingdom, Federal Republic of Germany, Japan, and Poland accounting for most of the remainder.

To boost the export value of mica, the Government established a committee to prepare a program for the development of mica-based industries. Since fabricated mica brings a significantly higher value than the processed mica, the Government was seeking to develop indigenous expertise in this sector. The Government's Mica Trading Corp. planned to set up a series of plants to produce mica capacitors, wet-ground and micronized mica powder, and mica paper. The German Democratic Republic was asked to prepare a feasibility report for a mica paper plant for domestic consumption

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and export. Negotiations were also underway with a U.S. firm for setting up a micronized mica powder plant.

The Indian Bureau of Mines located a new mica pegmatite mine in Mellore district of Andhra Pradesh. Reserves at the site were not determined. A second pegmatite ore body was indentified nearby.

MINERAL FUELS

Coal.—Coal continued as the principal source of commercial energy in India. The country's vast coal reserves were officially estimated at 84 billion tons. Production, however, remained static for the second year in a row, and the outlook for any significant increase in 1978 was not encouraging. Failure to increase production was due mainly to labor problems and shortages of electric power and explosives.[18]

Despite the impressive reserve figures, only about 25% fell in the proved category and most of this coal was of inferior grade with an ash content of 17% to 50%. Most of the coal is quite low in sulfur content, which is an advantage, but even the relatively small amount considered of coking quality is of such high ash content that serious problems in the steel industry could result.

India's coal industry faced a number of problems including surplus labor and a high rate of absenteeism, which affected cost and productivity. Coal India Ltd. (CIL), the Government-owned holding company for the coal industry, employed nearly 500,000 people, roughly 55% of the total mineral industry labor force. The surplus labor force totaled about 50,000. CIL was seeking to raise coal output by introducing sophisticated mining technology and equipment, but this contradicted the Government's policy of promoting more employment through the use of more labor rather than more capital equipment. At the same time, labor problems plagued the industry with over 490,000 employee-days lost in 1977, compared with 370,000 in 1975. Absenteeism in the coal sector averaged about 20% during 1977.[19]

Another major problem was the inadequate coal prices which have remained unchanged since 1975. According to CIL, the industry loses $1.18 on every ton of coal produced. Although a price hike was under consideration by the Government, it is likely that any raise granted would be offset by an increase in wages.

Other problems included increasing ash content in both coking and noncoking coal, shortages of railway cars, and inefficient operation of the coal washeries.

The 1978-83 Government plan called for an expenditure of over $2 billion to increase coal production by over 46 million tons per year by FY 1982. This was a considerable increase over the former 5-year plan but less than 3% of the total public-sector outlay for the period.

The plan stressed the need for short construction period projects and full-capacity utilization of existing mines. Emphasis will be on reconstruction and consolidation of existing mines and adoption of new mining technology with a stress on open pit mining. Roughly 60% of CIL's additional production was expected to come from open pit operations. One of CIL's affiliates, Eastern Coalfields Ltd. (ECL), planned to open 18 new mines and reorganize 28 existing mines by FY 1982. Of the new mines, nine are to be in Raniganj field, one at Bankura, six at Muguma, and two at Rajmahal. The ECL mines had special significance because the Raniganj mines produced some of the best metallurgical coal in India.

Lignite.—Total production in 1977 declined because of unusually heavy rains and a 16-day strike at the open pit workings, and the mine head value fell correspondingly $3 million to nearly $20 million. Nearly all of the lignite production came from the Neyveli complex in Tamil Nadu.

The lignite was used as the primary energy source for electric power generation in Tamil Nadu, which had no oil, natural gas, or coal deposits. Carbonized briquettes for domestic fuel and fertilizer were also produced at the complex.

Plans called for the expansion of production to 6.5 million tons annually by FY 1980, mainly through the purchase of additional earth-moving equipment estimated to cost about $150 million. The Government also approved the opening of a second mine cut with a capacity of 4.7 million tons annually and the installation of a 630-megawatt power station at the new mine. Cost of opening the second pit and powerplant was estimated at $440 million.

Petroleum.—The Indian Government reorganized the Oil and Natural Gas Commission (ONGC) at yearend 1977. Three new members were added giving a wider Government coverage to the membership. In addition, the onshore, offshore, and foreign activities of the ONGC now will be administered separately by executive directors with complete administrative control over their respective operations, subject to review of the ONGC. The changes should

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expedite the decisionmaking process and strengthen management control over the industry.

Total crude oil production increased significantly compared with that of 1976; the increase came from the Bombay High offshore oilfields, which began producing in May 1976. This offshore production contributed nearly 15% of total production, and several new wells were brought online during the year. Additional production platforms were being installed and a large increase in output was expected in 1978. Onshore production was nearly stable because output from some of the older fields was declining and a few new wells came online to maintain production.

Despite the encouraging rise in domestic production, India was still required to increase its imports by over 1 million tons in 1977 because demand rose faster than an ambitious exploration program could discover new supplies. Iran supplied about 40% of crude oil imports, and Iraq, Saudi Arabia, the U.S.S.R., and the United Arab Emirates accounted for most of the remainder. The total cost of both crude oil and finished-product imports reached a new high of $1.85 billion, a sizable increase over the 1976 total and about 30% of India's total import bill.

Two new refineries were under construction during the year—the 1-million-ton-per-year Bongaigoan refinery in Assam and the 6-million-ton-per-year Mathura plant in Uttar Pradesh. The Government ordered that particular attention be given to the design of polution-control equipment for the Mathura refinery because of its proximity to historical sites.

Construction continued on the major Salaya-Koyali-Mathura pipeline, which will bring crude oil from the Bay of Cambay to the Koyali and Mathura refineries. The U.S. firm Brown and Root Inc., working under contract to ONGC, began laying a 76-centimeter-diameter crude oil pipeline and a 66-centimeter-diameter natural gas pipeline from the Bombay High offshore oilfield to Uran on the coast near Bombay port, a distance of 200 kilometers. Completion of the lines in mid-1978 was to allow an increase in crude output and utilization of the natural gas, which is now reinjected into the oil reservoir or flared.

India was trying to expand its oil and gas resources as quickly as possible and was conducting an active exploration program both onshore and offshore. ONGC drilled 37 wells onshore and 13 wells offshore, and Oil India Ltd. drilled 10 wells. At yearend, three foreign rigs were working offshore on contract to ONGC. In addition, ONGC operated its own jackup rig, Sagar Samrat. Drilling on other geologic structures in the Bombay High area has proven additional oil discoveries of undetermined extent. Gas reserves, however, appeared to be much larger than originally believed. The Indian west coast industrial plans may need reassessment in light of the apparent favorable reserve situation, especially in regard to the fertilizer and electric power sector.

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[1]Physical scientist, Branch of Foreign Data.
[2]U.S. Regional Resources Attache, U.S. Department of State, New Delhi, India.
[3]The Indian fiscal year runs from April 1 through March 31. The period beginning April 1 of that stated will hereafter be referred to as FY (FY 1977, for example).
[4]Where necessary, values have been converted from Indian rupees (Rs) to U.S. dollars at the rate of Rs 8.50 = US$1.00.
[5]All figures are in metric tons (2204.6 pounds).
[6]Government of India, Central Statistical Organization. Monthly Abstract of Statistics, v. 32, No. 1, January 1978, pp. 3-5.
[7]Establishments employing 10 or more workers.
[8]U.S. Embassy, New Delhi, India. State Department Airgram A-200, Nov. 3, 1978, pp. 1-11.
[9]U.S. Embassy, New Delhi, India. State Department Airgram A-146, July 7, 1978, pp. 19-23.
[10]Pages 3-5 of work cited in footnote 9.
[11]U.S. Consul, Calcutta, India. State Department Airgram A-22, Aug. 4, 1978, pp. 4-5.
[12]Pages 30-32 of work cited in footnote 9.
[13]Page 33 of work cited in footnote 12.
[14]India News (Washington, D. C.). V. 17, No. 35, Nov. 27, 1978, p. 2.
[15]Fertilizer Association of India (New Delhi). Fertilizer Statistics-1977-78. November 1978, pp. 1-178.
[16]Geological Survey of India News (Calcutta, India). V. 10. No. 2, February 1979, p. 2.
[17]Fertilizer International. No. 103, January 1978, p. 14.
[18]U.S. Embassy, New Delhi, India. State Department Airgram A-169, August 1978, pp. 1-2.
[19]Page 9 of work cited in footnote 6.

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The Mineral Industry of Indonesia

By K. P. Wang[1]

Real growth in the Indonesian economy was about 7% during the fiscal year from April 1, 1977, to March 31, 1978, with exports providing the main impetus to expansion.[2] International monetary reserves were improved by $650 million, with reserves now surpassing $2 billion.[3] Prudent monetary and fiscal policies reduced inflation to a 10% annual rate and restored the confidence of the international financial community. President Suharto was reelected, portending stability and continuity of existing policies for the next 5 years. Oil revenues leveled off, and the long-term future of petroleum showed some uncertain aspects. Agricultural performance did not reach expectations with regard to closing the food gap and increasing traditional exports such as tobacco, tea, coffee, pepper, and palm oil. Recognition of the need for improving the investment climate gave hope at yearend that more foreign capital may be forthcoming.

Indonesia's gross national product was about $37 billion in 1976 and possibly exceeded $44 billion in 1977, measured in current prices. Oil output value increased from about $8 billion in 1976 to $9 billion in 1977. Gross petroleum exports in 1977 amounted to about $7.2 billion, contributing nearly 70% of total gross exports and one-half of Government revenues. Exports of liquefied natural gas (LNG) entered the trade accounts for the first time, although registering only $78 million in fiscal year 1977-78 compared with $400 million expected by 1980. Low world prices continued to plague both the nickel and copper industries. Royal Dutch/Shell Group's decision to delay development of its coal concession in Sumatra was a setback to the nonoil mineral economy, although the Government made progress in developing its own coal properties. High tin prices yielded record revenues for tin producers. Expansion programs in the cement and fertilizer industries made significant headway.

During 1977, the "hard rock" part of the mineral industry, which excludes oil and gas, fertilizers, cement, and iron and steel, consisted primarily of the operations belonging to three State mining companies and half a dozen relatively important private mining companies. P.N. Tambang Batubara, the State coal company, was trying to build up two small coal mines in Sumatra called Bukit Asam and Ombilin. Shell Internationale Chemie Mijnbouw B.V. has a production-sharing contract with Batubara to eventually develop a 10-billion-ton coal reserve property in Sumatra.

P.T. Tambang Timah is the large Government tin firm that controls most of the tin reserves as well as Indonesia's only tin smelter. Its new *Banka II* dredge designed to excavate 6.9 million cubic yards annually was being readied for service, and purchase of two additional large dredges for the Belitung and Kundur mines was being considered. Dutch-owned Billiton Exploratie Maatschappij Indonesia B.V., a subsidiary of Royal Dutch/Shell, was awaiting the arrival of an 8-million-cubic-yard-per-year dredge for use on its offshore leases. P.T. Koba Tin of Australia ordered two small tin dredges to supplement gravel pumps.

P.T. Aneka Tambang, the third State mining company, has responsibility with regard to all "hard rock" minerals except coal, tin, and radioactive minerals. In 1977, it produced 968,000 tons of 2.2% to 2.4% nickel ore at its Pomalaa mine in South-East Sulawesi for export to Japan, along with ferronickel at a plant built locally to utilize the low-grade nickel ores from the mine. Aneka Tambang's Bintan Island

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bauxite mines produced 1.3 million tons of bauxite during 1977, up 38% from the tonnage in 1976, all for export to Japan. Aneka Tambang was considering building a large alumina plant on Bintan and a steel billet plant to utilize the iron sands it produces.

P.T. International Nickel Indonesia (P.T. INCO) started construction of the second phase of its $850 million nickel project at Soroako, Central Sulawesi, which would eventually bring nickel-in-matte capacity to about 50,000 tons annually; a third phase was being planned, although there was great hesitancy on the part of the Canadian management to complete the project because of depressed nickel prices. The Ertsberg property of U.S.-owned Freeport Indonesia Inc. continued to suffer from low copper prices, and its management was hesitant to expand operations underground. A joint venture with Japan in chromite started production, and a joint venture with the United Kingdom in granite was trying to sell a surplus to Singapore. Work finally got underway on the mammoth Asahan hydroelectric powerplant and aluminum smelter project in North Sumatra. However, P.T. Indonesia Asahan Aluminum, a joint venture between the Indonesian Government and a Japanese consortium organized to develop the project, had to refinance it because of skyrocketing costs to over $2 billion, 2.5 times the original estimate of $800 million.

In June, P.T. Rio Tinto Indonesia signed a contract of work with the Indonesian Government covering an area of approximately 17,200 square kilometers in North Sulawesi. This was the first contract signed by the Indonesian Government with a foreign-owned mining company within the context of its "Third Generation Mining Contracts for Work." Thus, Rio Tinto Indonesia obtained rights to exploration and production of minerals other than oil, natural gas, and radioactive minerals. Exploration and other preproduction rights are vested in Rio Tinto Indonesia for up to 8 years and production rights, up to 30 years thereafter. The agreement also provides that an interest of up to 51% be offered to the Indonesian Government or its nominees over a 10-year period from the start of any mining operations. This contract is not only significant for Indonesia but could prove an important precedent for developing-country agreements elsewhere.[4]

The oil and gas industries made notable gains in production, with the large producer P.T. Caltex Pacific Indonesia maintaining the general level of the last few years and various lesser firms expanding output. The most notable gain was made by the French firm Total Indonesie at its Handil Field, but Union Oil Co. of Indonesia (a subsidiary of Union Oil Co. of California), with its main field Attaka; Atlantic Richfield Indonesia, Inc. (Arco), with its Arjuna Fields; Independent Indonesian American Petroleum Co. (IIAPCO), with its large field at Cinta; and Petromer Trend Corp., which operates in Irian Jaya (formerly New Guinea), also did well. The two large LNG projects, which may eventually cost nearly $2 billion, came into their own with regard to first-phase facilities. Specifically, Roy M. Huffington, Inc.'s (Huffco) Badak gasfield (some oil also) and the LNG plant in East Kalimantan were brought into production, and Mobil Oil Indonesia Inc.'s Arun gasfield (oil as well) and its corresponding LNG plant near Lho'seumawe were near completion. The Japanese side of the deals remained firm, whereas the U.S. west coast market became uncertain. Mobil has plans to build second-phase facilities as large as the first, in order to sell to the United States.

The latter part of 1977 and the first part of 1978 were a significant period in Indonesia's oil history. The final U.S. Internal Revenue Service (IRS) ruling clearly removed the double taxation threat from U.S. oil companies operating in Indonesia. (See Petroleum.) The State oil firm Perusahaan Negara Pertambangan Minjak dan Gas Bumi Nasional (Pertamina) offered new financial incentives and generally retreated to the standard production-sharing contract with regard to foreigners. As a result, exploration investments and the number of seismic crews and drilling rigs have risen about 50%. The immediate increase in exploration, however, may portend an initial decline in oil and gas production. At least four new joint venture contracts were being arranged, the latest with the Federal Republic of Germany's Deminex and Japan's Teikoku Oil Co., Ltd. The contracts would call for the foreign companies and Pertamina to share cost and production on a 50-50 basis, divide equally the oil and gas produced from specific areas, and conclude a standard production-sharing arrangement (an 85-15 split after recovery of costs) for the 50% of output retained by the foreign partner. The foreign firms would be obliged to offer 5% of their share to Indonesian investors once oil is discovered and to sell part of their output domestically. Deminex will work on a coastal strip in East Kalimantan, and Teikoku reportedly acquired rights in Djambi Province in southern Sumatra.

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With the reorganization of the Ministry of Mines into the Ministry of Mines and Energy, Indonesia's new energy policy began to take shape.[5] The pessimists say that Indonesian oil is exportable for only 15 years, and optimists predict no more than twice as long; however, there is clear agreement that energy conservation and efficient utilization concepts must be introduced and other forms of energy must be used as much as possible. Maintaining large exports of oil is fundamental, in any case, to earning the necessary foreign exchange. The substantial amounts of natural gas now being flared or capped could be put to work as domestic fuel. Development of the coals of Sumatra and, to a lesser extent, of Kalimantan (or Borneo) is considered important in energy policy. Hydropower potential may be close to 30 million kilowatts, and the hope is to increase production from less than 500,000 kilowatts to about 4 million kilowatts by the year 2000. The Indonesians say that the geothermal power potential may be as much as 8 million kilowatts, so development of nearly 500,000 kilowatts seems reasonable. Uranium should become important, with commercial deposits already found in Kalimantan and Sumatra. Firewood could be better utilized in rural areas. Solar energy may come into its own. A system of identifying specific energy resources and defining development priorities is a major aspect of the new policy.

PRODUCTION

Indonesia's mineral production showed sharp increases in bauxite, mine nickel, nickel products, mine tin, asphalt, cement, fertilizers, natural gas, crude oil, and refinery products; moderate increases in refined tin and iron sands; and reductions in mine copper, precious metals, and manganese. The program to rapidly increase cement capacity was gaining momentum, and other construction materials did reasonably well also. Despite a very impressive gain in natural gas output, more than half was still flared or capped. LNG projects came into their own. Development of the petrochemical and fertilizer industries also made significant headway. Production of nickel matte reached only two-thirds of phase 1 capacity and output of ferronickel was still under capacity, but production of mine nickel increased substantially during 1977, with new ore extracted for the smelter along with traditional ore for export. Mine copper output declined in both tonnage and value, with prices still very low. Indonesia's tin, nickel, oil, gas, and fertilizers are of considerable world consequence.

Table 1.—Indonesia: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
METALS				
Aluminum, bauxite, gross dry weight	thousand tons	993	940	1,301
Chromium, chromite, gross weight		--	[e]2,000	5,000
Copper, mine output, metal content		62,723	69,070	64,295
Gold metal[1]	troy ounces	74,954	85,690	64,466
Iron and steel, iron sand, dry basis		352,991	292,334	311,519
Manganese ore		13,682	9,833	5,976
Nickel:				
Mine output, metal content[2]		15,400	21,200	23,200
Ferronickel		--	16,886	21,574
Silver[1]	thousand troy ounces	1,033	1,072	790
Tin:				
Mine output, metal content		25,337	23,435	25,926
Metal		17,826	23,322	24,005
NONMETALS				
Asbestos		[r]92	[re]100	[e]60
Cement, hydraulic	thousand tons	1,089	1,804	2,678
Clays:				
Kaolin powder		30,528	29,323	36,676
Other (for cement manufacture)	thousand tons	271	380	NA
Diamond:				
Industrial[e]	thousand carats	12	12	12
Gem[e]	do.	3	3	3
Total	do.	15	15	15

See footnotes at end of table.

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Table 1.—Indonesia: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
NONMETALS —Continued			
Fertilizer materials:			
Crude, phosphate rock	7,902	7,565	3,149
Manufactured:			
Nitrogenous	402,440	366,327	NA
Other, including mixed	116,635	75,033	NA
Ammonia	58,728	224,952	NA
Iodine kilograms	33,007	27,290	20,465
Salt, all types thousand tons	52	213	563
Stone:			
Marble square meters	19,828	25,944	NA
Limestone[3] thousand tons	1,374	2,121	NA
Granite do	635	804	669
Quartz	139,613	165,219	269,310
Sulfur, elemental[4]	3,944	3,483	NA
MINERAL FUELS AND RELATED MATERIALS			
Asphalt rock, bitumen content	115,679	104,990	137,701
Carbon black	[r]2,752	1,715	974
Coal thousand tons	206	183	231
Gas, natural:			
Gross million cubic feet	222,234	312,392	533,355
Marketed do	82,224	82,883	199,951
Natural gas liquids:[e]			
Propane and butane thousand 42-gallon barrels	12	70	70
Natural gasoline do	38		
Petroleum:			
Crude do	477,055	550,319	615,123
Refinery products:			
Gasoline do	15,759	9,763	14,444
Jet fuel do	1,100	589	663
Kerosine do	22,425	13,818	19,887
Distillate fuel oil do	20,903	15,215	19,445
Residual fuel oil do	11,820	8,036	15,185
Lubricants do	31	14	24
Other:			
Liquefied petroleum gas do	336	291	299
Petroleum wax do	284	267	328
Naphtha do	3,409	1,835	100
Unfinished oils requiring further processing do	32,570	29,961	37,403
Unspecified do	2,361	1,145	--
Refinery fuel and losses do	2,381	2,411	5,503
Total do	113,379	83,345	113,281

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]Includes gold and silver content of copper ore and output by Government-controlled operations. Gold output by operators of so-called "People's" mines is unavailable but may be as much as 30,000 troy ounces per year.

[2]Excludes mine output directly converted into ferronickel and includes a small amount of cobalt which is not recovered separately.

[3]Data represent quantities of limestone used for cement production and exclude considerable amounts of limestone produced by enterprises under local jurisdictions for building materials, for crushed rock to be used as aggregate, and to burn for lime.

[4]Sulfur produced by other than the Frasch process.

TRADE

Indonesia's favorable balance-of-payments position improved further, with a surplus of $1.19 billion in 1977 compared with $0.74 billion in 1976. Oil exports increased considerably, and Pertamina's financial problems were being resolved. During 1977, total exports increased to $10.5 billion and total imports increased to $7.3 billion.

As would be expected, the largest share of Indonesia's trade is with Asia. In 1977, approximately 56% of all exports went to Asian countries, and roughly 58% of all imports came from Asian countries. Imports from Japan were about 28% of total imports, and exports to Japan represented approximately 40% of total exports. The United States continued to be Indonesia's second most important trading partner, furnishing about 13% of Indonesia's imports and taking about 28% of Indonesia's exports. Europe's share in 1977 was about 18% of the imports and just under 10% of the exports.

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Equipment and machinery represented roughly 40% of all imports in 1977. However, base metals aggregated 12%, mineral products 13%, and chemical products 8%.

Minerals, particularly oil, continued to be of overriding importance in total exports. Oil represented 68% of 1977 exports in value, and other minerals added another 3.5%. Gross receipts from Indonesia's exports were as follows, in million dollars:

Commodity	1975	1976	1977
Petroleum	5,311	r5,080	7,190
Tin	154	165	236
Copper concentrates	74	80	e80
Nickel ore	21	29	e30
Bauxite	6	13	e15
Other minerals	4	5	5
Nonminerals	r1,539	r2,157	2,980
Total	7,109	7,529	10,536

eEstimate. rRevised.

Table 2.—Indonesia: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Bauxite and concentrate	973,370	872,039	Japan 862,761.
Metal including alloys, all forms	90	192	Singapore 184.
Copper concentrate, gross weight	199,581	216,828	Japan 127,364; West Germany 89,464.
Iron and steel metal:			
Scrap	1,580	305	All to Singapore.
Pig iron, including cast iron	1,813	--	
Semimanufactures	1,265	133	Mainly to Singapore.
Lead ore and concentrate	150	--	
Manganese ore and concentrate	310,841	265,076	All to Japan.
Nickel ore and concentrate	639,020	565,357	Japan 559,419.
Silver metal including alloys, troy ounces	72,725	--	
Tin:			
Ore (including slag and ash)	10,056	1,526	All to Malaysia.
Metal including alloys, all forms:			
Scrap	2,965	14,517	Japan 5,814; Netherlands 4,060; United States 1,493.
Unwrought	5,772	2,875	Netherlands 1,130; United States 714.
Semimanufactures	5,517	6,126	Netherlands 2,485; Japan 1,422; United States 770.
Zinc metal:			
Scrap	134	164	All to Japan.
Unwrought and semimanufactures	945	706	Japan 496; Singapore 110.
NONMETALS			
Barite	35,011	5,186	NA.
Clays, kaolin	1,710	500	All to Japan.
Fertilizer materials:			
Manufactured, nitrogenous	921	80	All to Singapore.
Ammonia	352	1,522	Malaysia 822; Singapore 406; Thailand 194.
Stone, sand and gravel:			
Crude and partly worked, granite	82,409	307,963	All to Singapore.
Gravel and crushed rock	9	8,978	Do.
Other:			
Bromine, iodine, fluorine	9	9	All to France.
Slag, dross, and similar waste from iron and steel manufacture	169	--	
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	2,783	5,917	Japan 3,475; Netherlands 1,218.
Petroleum:			
Crude, thousand 42-gallon barrels	397,261	442,929	Japan 197,710; United States 163,523.
Refinery products:			
Gasoline, motor, do.	r472	48	NA.
Kerosine, white spirit, do.	18,368	27,002	Japan 23,931.
Distillate fuel oil, do.	--	41	NA.
Residual fuel oil, do.	6,928	2,000	Japan 1,733.
Lubricants, do.	6	--	
Other:			
Paraffin wax, do.	r2,734	259	Singapore 185.
Nonlubricating oils, do.	55,458	--	
Total, do.	r83,966	29,350	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	8	17	All to Japan.

rRevised. NA Not available.

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Table 3.—Indonesia: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite and concentrate	2	100	All from Singapore.
Oxide and hydroxide	4,804	7,633	Japan 3,901; Singapore 1,000; People's Republic of China 980.
Metal including alloys:			
Scrap	147	735	Mainly from Australia.
Unwrought	6,995	8,401	Japan 4,071; New Zealand 998; Australia 797.
Semimanufactures	15,854	16,282	Japan 8,103; United States 1,283; France 1,085.
Arsenic trioxide, pentoxide, acids	43	27	West Germany 10; France 6; United Kingdom 5.
Chromium oxide and hydroxide	70	79	Japan 49; West Germany 9; United States 7.
Cobalt oxide and hydroxide	11	38	Netherlands 32; People's Republic of China 5.
Copper:			
Copper sulfate	105	135	France 75; Japan 33; West Germany 15.
Metal including alloys, all forms	7,083	11,541	Japan 5,993; Australia 3,449; West Germany 1,424.
Iron and steel:			
Ore and concentrate	13	21	Australia 10; Sweden 10.
Metal:			
Scrap	16,043	29,462	Taiwan 12,508; Japan 7,283; Singapore 4,628.
Pig iron, ferroalloys, similar materials	11,518	19,141	India 10,284; Japan 3,110; Taiwan 1,924.
Steel, primary forms	95,518	130,099	India 62,136; Japan 45,122.
Semimanufactures:			
Bars, rods, angles, shapes, sections	351,224	315,098	Japan 210,774; Australia 32,799.
Universals, plates, sheets	344,334	492,825	Japan 403,386.
Hoop and strip	35,196	35,431	Japan 32,854.
Rails and accessories	27,840	10,382	West Germany 3,324; United Kingdom 2,357; Australia 1,414.
Wire	7,113	5,356	Japan 3,681; Belgium-Luxembourg 660.
Tubes, pipes, fittings	201,586	148,647	Japan 75,100; United States 23,714.
Castings and forgings, rough	6,255	--	
Lead:			
Oxides	469	292	Australia 219.
Metal including alloys, all forms	3,589	4,175	Australia 2,668; Japan 577.
Magnesium metal including alloys, all forms	160	64	Japan 60.
Manganese:			
Ore and concentrate	4,802	4,826	Singapore 3,642; United States 534.
Oxides	1,685	2,423	Japan 2,349.
Mercury 76-pound flasks	684	165	West Germany 111; Japan 30.
Nickel metal including alloys, all forms	1,345	764	Japan 617; United States 64.
Platinum-group metals including alloys, all forms troy ounces	r108	74	United Kingdom 64.
Tin:			
Oxide	200	(1)	All from United States.
Metal including alloys, all forms	154	148	United States 51; Singapore 38; Japan 25.
Titanium oxides	3,931	5,052	Japan 3,280; West Germany 857.
Tungsten metal including alloys, all forms	12	19	Japan 17.
Uranium and thorium oxides and other compounds	r25	84	France 52; Hong Kong 15; Switzerland 10.
Zinc:			
Oxide	r1,647	1,016	Australia 297; West Germany 233.
Metal including alloys:			
Scrap and blue powder	875	340	Australia 320.
Unwrought and semimanufactures	r21,759	32,047	Australia 20,724; Japan 8,321.
Other:			
Ores and concentrates	69	--	
Ash and residue containing nonferrous metals	12	10	Mainly from West Germany.
Oxides, hydroxides, peroxides of metals, n.e.s	399	--	
Metals including alloys, all forms:			
Metalloids	18	57	West Germany 48.
Alkali, alkaline-earth, rare-earth metals	94	19	Hong Kong 10; United Kingdom 5.
Pyrophoric alloys, ferrocerium	12	90	People's Republic of China 68.
Base metals including alloys, all forms, n.e.s	74	143	Japan 86; West Germany 30.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	418	340	Netherlands 112; Japan 91; West Germany 51.
Dust and powder of precious and semiprecious stones	1	3	Mainly from Denmark.
Grinding and polishing wheels and stones	369	582	People's Republic of China 132; Taiwan 118; Japan 94.
Asbestos	4,845	9,340	Canada 3,944; People's Republic of China 1,165.
Barite and witherite	69,730	51,835	Thailand 44,786.

See footnotes at end of table.

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Table 3.—Indonesia: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Boron materials:			
Crude natural borates	149	64	United States 63.
Oxide and acid	254	121	United States 73; United Kingdom 18.
Cement thousand tons	1,609	1,431	Japan 611; Republic of Korea 301; Philippines 241.
Chalk	525	587	Philippines 424; United Kingdom 94.
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite	r4,782	15,514	United States 6,337; Thailand 5,503; India 2,824.
Kaolin	5,769	4,116	Japan 1,645; Malaysia 1,300; Singapore 624.
Kyanite	41	1	All from West Germany.
Other	4,008	2,305	United States 909; Singapore 466; Japan 358.
Products:			
Refractory (including nonclay brick)	18,927	19,265	Japan 8,081.
Nonrefractory	4,319	3,055	Japan 689; Australia 363; West Germany 360.
Cryolite and chiolite	15	(1)	All from Netherlands.
Diamond, industrial carats	27,240	750	All from United States.
Diatomite and other infusorial earth	463	375	Malaysia 90; Republic of Korea 80; West Germany 74.
Feldspar, leucite, nepheline	1,144	2,584	India 1,289; Italy 700.
Fertilizer materials:			
Crude:			
Nitrogenous	915	647	Netherlands 500; Taiwan 67.
Phosphatic	11	46	United States 45.
Potassic	1,401	7	Singapore 6.
Manufactured:			
Nitrogenous	751,739	35,574	Japan 19,015; West Germany 8,568.
Phosphatic	388,701	49,163	Tunisia 11,000; West Germany 8,399.
Potassic	28,733	42,400	West Germany 19,766; Canada 6,490.
Other, including mixed	r28,142	4,755	Australia 1,500; Netherlands 1,049.
Ammonia	69	222	Singapore 96; Japan 86.
Graphite, natural	165	93	Japan 62; Pakistan 15.
Gypsum and plasters	47,556	79,753	Japan 42,432; Australia 28,174.
Lime	2,690	2,278	Japan 1,663; Singapore 448.
Magnesite	45	95	Japan 60; People's Republic of China 20.
Mica, all forms	r786	581	United States 413; Japan 129.
Pigments, mineral:			
Natural, crude	227	395	People's Republic of China 325; Japan 62.
Iron oxides, processed	645	931	West Germany 404; People's Republic of China 369.
Precious and semiprecious stones, except diamond, manufactured value	$24,000	$715,000	All from Taiwan.
Pyrite	4,967	5,310	Philippines 5,300.
Salt and brine	181,246	319,684	India 250,607; Australia 64,686.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	46,619	58,846	Netherlands 23,353; West Germany 11,870; United States 11,041.
Caustic potash and sodic and potassic peroxides	4,419	569	Japan 204; West Germany 75; Australia 70.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	1,710	731	Malaysia 425; Burma 225.
Worked	2,862	6,248	Malaysia 2,707; Japan 1,672; People's Republic of China 1,152.
Dolomite, chiefly refractory grade	1,625	1,995	Taiwan 1,501; Japan 442.
Gravel and crushed rock, n.e.s	433	270	Singapore 115; Malaysia 86.
Limestone (except dimension)	225	94	Japan 50; New Zealand 25; Taiwan 11.
Quartz and quartzite	101	2	Netherlands 1.
Sand, excluding metal bearing	2,045	1,280	United States 456; Singapore 437; Japan 139.
Strontium minerals	425	393	Japan 292; West Germany 68.
Sulfur:			
Elemental:			
Other than colloidal	1,125	616	Taiwan 399; Singapore 155.
Colloidal	12,166	18,164	Canada 11,000; Singapore 3,559.
Sulfur dioxide	13	15	West Germany 13.
Sulfuric acid (including oleum)	571	1,345	Singapore 692; Japan 418.
Talc, steatite, soapstone, pyrophyllite	5,138	7,744	People's Republic of China 5,814; Taiwan 768.
Other:			
Crude	27	352	United States 327.
Slag, dross, and similar waste, not metal bearing	r111	430	NA.
Oxides and hydroxides of magnesium, strontium, barium	114	605	Japan 480.
Bromine, iodine, fluorine	13	7	United Kingdom 6.

See footnotes at end of table.

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Table 3.—Indonesia: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	21,067	32,179	Singapore 21,575; Taiwan 10,036.
Carbon black and gas carbon:			
Carbon black	9,180	12,222	Australia 8,680; Japan 2,540.
Gas carbon	51	8	Mainly from France.
Coal, all grades, including briquets	13,461	9,342	Vietnam 9,255.
Coke and semicoke	15,666	13,085	Japan 7,440; Taiwan 4,398.
Hydrogen and rare gases	44	37	Singapore 14; Japan 12; Netherlands 5.
Peat, including peat briquets and litter	--	[1]	All from United States.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	3,333	3,043	Singapore 2,061; U.S.S.R. 419.
Refinery products:			
Gasoline do	447	4,777	Singapore 4,698.
Kerosine and white spirit do	3,374	8,203	Singapore 7,924.
Distillate fuel oil do	970	2,325	Singapore 2,250.
Residual fuel oil do	5,395	5,276	Singapore 5,112.
Lubricants (including grease) do	721	364	Singapore 98; United States 94; Japan 90.
Other:			
Liquefied petroleum gas do	62	2	Mainly from Singapore.
Mineral jelly and wax do	11	25	People's Republic of China 5.
Nonlubricating oils, n.e.s do	1,032	156	Singapore 70; Japan 35.
Bitumen and other residues and bituminous mixtures, n.e.s do	r1,232	707	Singapore 506; Taiwan 95.
Pitch, pitch coke, petroleum coke do	21	30	Taiwan 26.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	1,963	2,280	Singapore 1,133.

rRevised. NA Not available.
[1]Less than 1/2 unit.

COMMODITY REVIEW

METALS

Aluminum and Bauxite.—Aneka Tambang's high-silica trihydrate bauxite mines on Bintan Island near Singapore produced at a rate considerably higher than in 1976, as reflected by Japan's reported imports from Indonesia of 967,255 tons in 1976 and 1,207,699 tons in 1977. So far, Japan has been the sole purchaser of Indonesian bauxite. Aneka Tambang moved ahead on a $450 million (previously $400 million) alumina project on Bintan to produce 600,000 tons of alumina annually. An earlier Soviet offer to help with a large loan never reached fruition. However, a feasibility study made by Kaiser Engineers International Inc. probably will still be used by the new consortium about to be named to carry out construction of the alumina project. The Klöckner interests of the Federal Republic of Germany, together with Aluminum Co. of America (Alcoa) as a lesser partner, have the best chance of landing the contract, and Saudi Arabia may extend a loan. The plan is to sell most of the alumina produced in the future to the Asahan aluminum complex to be built in Sumatra and to provide 150,000 tons for export, possibly to the Middle East, by the early 1980's. The Bintan project will probably take at least 42 months to complete.

The initial plan for the Asahan aluminum and hydropower project is to develop just over 500,000 kilowatts of electricity on the Asahan River in North Sumatra, about one-half each at Sigura-gura and Tangga. About 80% of the electricity will be used by the aluminum plant, leaving the rest for general distribution. The powerplant site is near Toba Lake, a sightseeing resort 260 kilometers from the port of Balawan. The aluminum plant of 225,000-ton-per-year capacity presumably will be built at Kuala Tanjung, 120 kilometers from the powerplant and 45 kilometers east of Tebingtinggi. A good-size port is included in the plans. Indonesia considers the Bintan alumina complex and the Asahan aluminum complex and powerplant as important foundations for its emerging power, chemical, and heavy industries.

The Asahan aluminum project, a symbol of Indonesian-Japanese economic cooperation, ran into serious financial difficulties at yearend.[6] Asahan was scheduled to be one of the most important projects in Indonesia's second 5-year plan and its largest single foreign investment venture. The Japanese view it as not only a great technical challenge but a source of low-cost aluminum. Virtually all of the large Japanese

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aluminum companies, along with the Japanese Overseas Cooperation Fund, have banded together into a consortium to work on this very significant project, and the Indonesian Government committed itself to a 10% equity stake initially; the resultant joint venture is known as P.T. Indonesia Asahan Aluminum.

Construction costs, including infrastructure and research expenses, were originally estimated in 1975 at just over $800 million, including about 30% for electric power development, 60% for aluminum-smelting facilities, and 10% for long-term working funds. However, by yearend 1977, the expected overrun was in excess of $1 billion, owing to the sharp increase in the value of the yen, inflation, proposed hydroelectric powerplant design changes, and similar commitments by Japanese aluminum companies in another aluminum project in Brazil. The original plan was to complete the project by about 1984, but many thorny financial problems must be solved before construction can be undertaken.

Chromite.—Chromite output was officially reported for the first time in Indonesia. Apparently, about 5,000 tons of 40%- to 42%-Cr_2O_3-grade chromite was produced in the country during 1977, with a value of $65 per ton f.o.b. The Indonesian firm P.T. Perto and Japan Sulawesi Chrome Development, Ltd., had earlier provided an initial outlay of $1 million to investigate an area 35 miles south of the port of Parepare in Sulawesi with the hope of eventually producing 20,000 to 40,000 tons of chrome (or chromite) annually.

Copper.—Freeport Indonesia's predominantly private Ertsberg operation in Irian Jaya (Indonesia's only primary copper producer) had a reasonably successful year in a technical sense but a difficult year financially, in view of the low copper prices. The average copper price went down from $0.64 per pound in the first half of 1977 to $0.55 per pound in the second half of the year, below Freeport Indonesia's break-even point of close to $0.59 per pound. Yet for general reasons, a shutdown was not feasible. There were also some local political disturbances that affected output and shipments somewhat. Actual production in 1977 dropped below the 190,000-ton level in terms of concentrates, a sizable decline from the 1976 level. Approximately two-thirds of the output went to Japan and the rest to the Federal Republic of Germany for smelting, although these countries were reluctant to take these amounts because of the worldwide recession. The company is expected to be under considerable strain to repay debt obligations, which amount to $17 million to $18 million annually in 1978-80.[7]

Ertsberg means "ore mountain," and mining of this ore body in the hills is presently by open pit methods, with ore brought down to the mill at a lower level and concentrates finally slurried to the sea-level port of Amampare. The concentrate pipeline was damaged in July but was subsequently repaired. Exploration was continuing on an underground mine realized zone about 1 mile east of the open pit, with a 1,400-meter tunnel being driven for collecting samples. Fluor Corp. is in charge of this project, which is scheduled for completion by yearend 1978, at which time a decision will be made as to whether or not to open up an underground mine also.

A copper exploration project controlled by Taiwan Metal Mining Co., with 45% Singapore money and 10% Indonesian money, made some headway during 1977. This joint undertaking, called P.T. Copperindo, was working under a "Third Generation Mining Contract" to search for copper in the Tasikmalaya area of West Java. Initial drilling proved promising, and inquiries were being made to engage the services of Morrison-Knudsen International Co. of San Francisco to do a feasibility study.

Gold and Silver.—Indonesia was exploring in the Cimari and Lembak Seembada areas of West Java during 1977 as part of its efforts to support and perhaps expand the Cikotok gold and silver mine in southern Banten, the only sizable gold operation in Indonesia. This mine is owned and operated by the State corporation Aneka Tambang. A preliminary survey showed that reserves here would only last about 10 years at recent production levels. In fact, its output has been declining, of gold from 10,700 troy ounces in 1976 to 8,230 troy ounces in 1977 and of silver from about 153,000 troy ounces in 1975 to 109,000 troy ounces in 1976 and 91,000 troy ounces in 1977.

Precious metals are also produced as byproducts of copper from the Ertsberg mine whose concentrates analyze about 0.297 troy ounce of gold and 3.70 troy ounces of silver per ton. Thus, gold output from copper was approximately 56,000 troy ounces in 1977 and silver output, nearly 700,000 troy ounces. Because of the difficulty in selling copper, precious metals byproduct production declined about 13% from that of 1976.

Aneka Tambang also discovered gold reserves in southern Kalimantan. Indonesia actually produces much more gold than has been recorded as stated here. It has been said that unrecorded production of precious

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metals from small mines in Kalimantan and Sumatra may be several times the quantities mentioned for the Cikotok enterprise.

Iron and Steel.—Indonesia's 1977 steel news was still centered around Government-owned P.T. Krakatau Steel, with facilities at Cilegon in West Java, 75 miles west of Jakarta. The historical background of this enterprise was described in the 1976 edition of this chapter. Two small steel mills—a 150,000-ton-per-year reinforcing rod mill and a 100,000-ton-per-year angle mill—were completed in early 1977, and others are to be built. Krakatau's 4-unit HyL-process direct-reduction plant was moving ahead roughly on schedule. Each unit is rated at about 500,000 tons per year of sponge iron and is designed to use Australian high-grade iron ore and natural gas from the Arjuna offshore field in Central Java.[8] All units were under construction at yearend, with the first unit planned to be operational in 1979 and the others a year or more later. About 500,000 tons of the sponge iron will be consumed by Krakatau itself to make steel, the same amount will be sold to private Indonesian steelmakers, and the remaining 1 million tons will be exported in the first years of operation.

Indonesia's annual steel demand already exceeds 1.5 million tons, with prospects of doubling by 1985 and reaching 4 million tons by 1990. Development of the integrated Krakatau steelworks is aimed at meeting part of the future demand. The country actually has just over 30 small private steel plants.[9] Together, these plants can manufacture more than 1 million tons per year of steel products, mostly bars, rods, ingots, billets, and pipes. At least seven of these plants produce billets from scrap, whereas most of the others work on imported semimanufactures. In 1977, local producers were having trouble from foreign competition.

The Indonesians hope to develop some local iron ore in the future, from places such as the Lampung area of South Sumatra and areas in Kalimantan. Meanwhile, the plan is to use imported iron ore. However, the country produces small quantities of iron sands for sale to Japan, which reported imports of 283,310 tons in 1976 and 279,725 tons in 1977. The sands analyze about 55% iron and 10% titania and are produced by Aneka Tambang east of Tjilatjap along the southern coast of Java. Of late, the Indonesians have been thinking about exchanging oil for Brazilian high-grade iron ore, for use by the Krakatau enterprise.

Manganese.—Indonesia's output of manganese ore declined further to about 6,000 tons (88% MnO_2 grade) in 1977, less than one-third of the peak output of 1974 and less than one-half of the output of 1975. Lack of demand from Japanese buyers brought about the steady drop in manganese production, with some producers accumulating moderate stockpiles. All the mines are small, and most work is done manually, as the majority of the mines are in Java where foreign operations are not permitted in manganese extraction except under special circumstances. Apparently, P.T. Gama Karya has a deposit near Pulau Doi, P.T. Miga Lima has a deposit in Bima (located within West Musatenggara), and P.D. Perusahaan Pertamgangan Yogyakarta was trying to develop a 10,000-ton-per-year mine with the help of the Japanese.[10]

Nickel.—Aneka Tambang, Indonesia's State mining company for nonfuel minerals other than tin, has indicated that known nickel reserves in the country may be about 14 million tons of nickel content or possibly 15% of the world's reserves.[11] Gag Island nickel reserves may be 6 million tons, and Central Sulawesi's reserves may be on the order of 3 million tons. Indonesia's resources are all nickeliferous laterites, containing more than 25% water and 1% to 3% nickel in the ore; these laterites are much more expensive to process than the sulfides which are extracted, for example, in Canada.

Indonesia's nickel in all forms will be entirely exported until the country develops a viable steel industry. However, there will always be large surpluses. In 1977, Japan imported the entire output of high-grade (about 2.2% to 2.4% nickel) nickel ore from Aneka Tambang's mine at Pomalaa in South-East Sulawesi. Aneka Tambang's new ferronickel smelter (4,000 tons per year of contained nickel) is designed to use the lower grade ores of Pomalaa. Japan took 6,321 tons of this ferronickel in 1976 and 8,605 tons in 1977. The 75% nickel matte produced by P.T. INCO at Soroako was mostly exported to Japan.

Indonesia's largest nickel project, the Soroako enterprise in Central Sulawesi owned 75% by the Canadian firm Inco Ltd. and 25% by Japanese firms, was having startup and slowdown problems in 1977. P.T. INCO was working seven local deposits to supply 2.2% nickel ore to its new matte smelter whose phase 1 processing line, rated at 16,800 tons per year of contained nickel, was completed in late 1976. To make 75%-grade nickel matte, P.T. INCO obtains sul-

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fur from its parent company in Canada. At yearend, phase 1 of the smelter was still running at only two-thirds of capacity because of ore-grade control problems (it was employing selective mining) and malfunctioning of the 100-meter-long reduction kiln in handling sticky (high-moisture) uneven-grade ores. Upgrading the crude nickel matte from rotary kiln and electric furnace into high-grade nickel matte in converter presented no problem.

Two other similar-size processing lines for phase 2, scheduled to be completed by 1978, were delayed at least until 1979 because of the need to redesign kilns and the generally depressed world nickel market. Phase 2 operation is also contingent upon completion of a 165,000-kilowatt powerplant on the La Rona River. Although the latest figure mentioned for capital cost was $850 million, it would hardly be surprising if the actual cost were higher. At the height of construction, there were 11,000 workers, compared with 4,000 expected when the project is totally completed. Most output will go to the Japanese market in the next few years, with prospects of ultimately selling to the People's Republic of China also.

Construction of P.T. Pacific Nikkel Indonesia's project on Gag Island, off the western extremity of Irian Jaya, has been delayed until at least 1979, with the completion date moved back to 1983. In view of the large capacity of this proposed project—51,000 tons per year of nickel powder or briquets and 1,000 tons per year of nickel and 550 tons per year of cobalt contained in mixed sulfide concentrates—development of the Gag Island project, along with the Soroaka project, would propel Indonesia into a prominent world position in nickel production. Pacific Nikkel has already spent $50 million on this project, which may cost as much as $1 billion to implement. United States Steel Corp., the Dutch steelmaker Hoogovens IJmuiden B.V., Newmont Mining Corp., Sherritt Gordon Mines Ltd., and Mueller Co. were the initial partners of the consortium. However, the latter three backed out, although Sherritt Gordon is still interested in participating in the role of technical consultant. Meanwhile, Amoco Minerals (a subsidiary of Standard Oil Co. of Indiana) joined up as partner, and the Indonesian Government agreed to take 20% equity for World Bank financing purposes. The original consortium had a 30-year work contract dating from 1969, and negotiations were made to extend the project's preconstruction exploration permit another 18 to 24 months because of the depressed world market for nickel. Using a cutoff grade of 1.5% nickel ore, reserves may be twice as much as P.T. INCO's project in Sulawesi.

Tin.—Indonesia's tin output continued to rank behind that of Malaysia, the U.S.S.R., and Bolivia and just ahead of Thailand and the People's Republic of China. Actual reported production of both mine and refined tin were in the 24,000- to 26,000-ton range in 1977, which was roughly one-half of the historic output level in the case of mine tin. The output value increased by about $75 million, judging from tin exports of $236 million. Prices rose sharply during 1977, reaching considerably over $5 per pound near yearend. These high prices stimulated smuggling activities, and the result was that at least 1,000 tons of mine tin was smuggled out of the country without being reported as production. Expansion plans underway indicate that mine output in the year ahead might be 3,000 tons greater than in 1977. Almost all of the local concentrates were smelted at Indonesia's only tin smelter located at Muntok on Bangka Island. Consideration is being given to installing a fourth reverberatory furnace at this smelter to replace the West German rotaries now being operated, and increasing capacity slightly in the process.

Timah, the State-owned tin company, dominates the tin industry, controlling well over 90% of the concentrates produced and all of the refined tin. Timah's tin comes primarily from three famous tin islands south of Singapore and east of Sumatra. Timah's mine tin production in 1977 was 17,721 tons on Bangka, 4,800 tons on Belitung, 1,411 tons on Singkep, and 88 tons at Bangkinang. In total, the company has about 500,000 tons of recoverable tin reserves. Timah's "crash" exploration program yielded important additional reserves on Belitung, reestablishing the island's operating life at about 30 years. As of yearend, Timah had twelve 9- to 18-cubic-foot-bucket fixed dredges on Bangka, fourteen 5- to 14-cubic-foot-bucket fixed dredges on Belitung, and four 5- to 14-cubic-foot-bucket fixed dredges on Singkep. Timah's 22- to 24-cubic-foot-bucket dredge capable of digging to a depth of 50 meters, ordered from the United Kingdom's F. W. Payne but being built by Japan's Mitsubishi Heavy Industries, Ltd., for $21 million, might be ready for service before the end of 1978. This dredge, to be named *Bangka II*, is designed to excavate 6.9 million cubic yards annually.

Billiton has offshore contract rights in an area between Bangka and Singkep Islands.

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This firm, with shares and board members from Timah, has ordered the world's largest-bucket tin dredge for work near the Tujuh Islands. This "monsoon weather," $25 million dredge being built at the Jurong shipyard in Singapore will have 30-cubic-foot buckets capable of dredging about 8 million cubic yards per year at a 45-meter depth.[12] It should be ready for service before yearend 1978. In addition to the Tujuh Islands, where reserves have been initially estimated at 15,000 tons of recoverable tin good for about 6 years of operations, Billiton has a 40-year concession elsewhere, dating from 1968.

P.T. Hill Pty. Indonesia, a subsidiary of Broken Hill Pty. Co. Ltd. (BHP) of Australia, was having a very difficult time trying to develop some business in Indonesia. However, the board chairman of Australia's largest publicly held industrial concern indicated that BHP has no immediate plans to pull out and intends to work out future plans with the Indonesian Government. BHP's concessions extend only to nonalluvial tin deposits, and its main interest has been the Kelapa Kampit underground mine on Belitung. BHP's investment of more than $10 million already to rehabilitate this flooded old Dutch mine has created only a marginally profitable enterprise despite very high prices. Reserves cannot be ascertained unless large expenditures are made to dewater the lower portions of the mine. There is a pilot-scale concentrate. The mine produced 296 tons of mine tin in 1977.

Koba Tin, a subsidiary of Kajuara Mining Corp. Pty. Ltd. of Australia, with one-fourth of the shares belonging to Timah, produced 1,610 tons of mine tin in 1977 from its Nibung property on Bangka. Another property called Lubuk-Besar was shut down temporarily. Koba Tin has onshore reserves on 350 hectares amounting to 35,000 to 47,000 tons of mine tin and unreported quantities of reserves offshore on 2,800 hectares.[13] Koba Tin started with gravel-pump operations but has since ordered two small 3-cubic-foot-bucket dredges. All of the tin produced by this company is marketed and smelted through Timah.

NONMETALS

Cement.—Indonesia was on schedule in its plans to raise cement output by about 5 million tons during the 5-year period ending in 1980 and by more than 5 million tons again by 1985 when national demand is expected to exceed 12 million tons. The objective is to attain self-sufficiency as the country moves rapidly forward in its industrialization program.

Cement production in 1977 increased by nearly 900,000 tons over the 1.8 million tons produced a year earlier, and prospects are that 3.5 million tons will be produced in Indonesia during 1978.

P.T. Semen Cibinong, an Indonesian private joint venture with Kaiser Cement & Gypsum Corp., completed its first-stage expansion program in 1977 at a cost of about $50 million, with Fuller Co. supplying the key equipment. Annual capacity of its West Java plant was raised to 1.2 million tons in the process. Cibinong hopes to double capacity again during the third 5-year plan period ending in 1984. With net earnings of over $10 million, Cibinong enjoys a tax holiday through September 1980.[14]

P.T. Semen Gresik, a Government firm engaging the engineering services of Morrison-Knudsen, was in the process of tripling the capacity of its plant in East Java to 1.5 million tons per year by 1978. P.T. Semen Padang retained F. L. Smidth & Co. to build a 700,000-ton-per-year dry-process plant next to its old wet-process plant located in Indarung, West Sumatra. Another cement works, Indarung 3, is scheduled for completion before 1985. Mitsui & Co., Ltd.'s 600,000-ton-per-year plant at Cilacap in Central Java was nearing completion, with a second plant on the drawing board. Other cement works scheduled to be built include Tonasa 3 in South Sulawesi, Mohorok 1 in North Sumatra, and plants in East Nusa Tenggara, Irian Jaya, and Cirebon. Kawasaki Heavy Industries Ltd. will build a clinker plant at Bataraja and grinding plants at Palembang, both in South Sumatra.

Fertilizer Materials.—Indonesia's program to achieve self-sufficiency in fertilizers, based primarily on effective utilization of domestic natural gas resources, made significant headway in 1977. At the start of the year, Indonesia had only about 530,000 tons per year of urea capacity (urea contains 46% nitrogen), although three 570,000-ton-per-year urea plants were being built, and two more plants of the same size were planned. One of the large projects undergoing expansion is the Pusri ammonia-urea complex near Palembang in South Sumatra, with Kellogg Overseas Corp. having the management responsibility. The Pusri III and Pusri IV units, which are of the standard 570,000-ton-per-year size, had been completed by yearend, bring-

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ing the total annual capacity of the complex to about 1.6 million tons. Kellogg has also been constructing another 570,000-ton-per-year urea plant at Cikampek in West Java for P.T. Kujang, scheduled for completion at yearend 1978 with the help of a $200 million Iranian loan. Still another urea plant of this size, being built by August Thyssen-Hütte AG at Aceh in North Sumatra for the Association of Southeast Asian Nations (ASEAN), was also well on the way toward completion. The country's ammonium sulfate capacity was being expanded to approximately 300,000 tons per year. Indonesia was also building triple superphosphate and compound fertilizer plants at Gresik and elsewhere.

Iodine.—Iodine has been produced in East Java for several decades. The only important current producer is P.T. Kimia Farma, whose plant at Mojokerto provided 33.0 tons of iodine in 1975, 27.3 tons in 1976, and only 20.5 tons in 1977. Indonesian iodine is used in the pharmaceutical industry. The Japanese firms Mitsui and Ise Chemical Industries Co., Ltd., were hoping to develop additional iodine prospects in Indonesia in cooperation with Kimia Farma; however, no production had as yet been reported.

Stone.—*Granite.*—P.T. Karimun Granite, a joint venture with British Bovis Engineering of Hong Kong, was Indonesia's sole producer of granite in 1977. The bulk of the production was used in constructing Pertamina's LNG facilities in North Sumatra and East Kalimantan. Pertamina's financial difficulties, however, have forced Karimun Granite to sell its surplus to Singapore. Output in 1977 was about 670,000 tons, only one-fourth of the long-term annual target planned for the 1980's.

MINERAL FUELS

Coal.—Indonesia has only a minor coal industry. In 1977, two small coal mines together produced only 231,000 tons of medium calorific value subbituminous coal. Both mines are located in Sumatra. The Bukit Asam mine near Palembang, with possibly 150 million tons of hard coal reserves and nearly 2 billion tons of lignite, might be expanded to 2.5 million tons per year by 1985. The Ombilin mine near Padang, with 100 million tons of reserves as an order of magnitude, has a chance to be expanded to roughly 1 million tons per year. The Japanese firm Sumitomo Coal Mining Co., Ltd., was interested in this mine as a source of steam coal imports and will undertake a feasibility study before making any commitments. The Indonesians have become increasingly interested in developing coal for domestic and foreign markets to cut down on oil use and free more oil for exports. The Government coal company Batubara was created both to produce coal and to direct the coal development program, and is thus in charge of the Bukit Asam open pit operations and the Ombilin underground operations.

Batubara was getting ready to start implementing a very substantial project based on the Bukit Asam mine in South Sumatra. Upgrading and expanding this mine would entail possibly $100 million. However, the project calls for investing $35 million to improve railroads for shipping the coal out, $85 million for ports and a sea transport system to move coal to West Java, $450 million for two 375-megawatt generators and related facilities, and $350 million for transmission lines and a power supply grid in Java. The World Bank will assist in the project, and additional short-term borrowings will be sought also. Dravo Corp., Fluor Corp., and Morrison-Knudsen of the United States, Mineral Engineering of Canada, and Davy International Ltd. of the United Kingdom are among the firms interested in bidding for the contracts.[15] This project will be mainly for the domestic market, supplying fuel for power and raw materials for industry.

A much larger deposit near Bukit Asam was discovered by Shell International, of the Royal Dutch/Shell Group. Reserves are said to be 10 billion tons, but the coal is high in water content and is basically lignitic. A production-sharing contract signed with Batubara, committing Shell International to possibly $1 billion and up to 25 million tons of annual output, however, was postponed indefinitely in late 1977. The coal quality was not up to expectations, and the hoped-for Japanese market was not receptive for the time being.

Natural Gas.—Indonesia's natural gas is expected to become a major foreign exchange earner by the 1980's, although it is overshadowed by crude oil. Most of the natural gas is flared or capped. However, a pipeline was completed between Cilegon and the Jakarta area near yearend that is intended to supply natural gas to cement, steel, and fertilizer plants in the near future. Gross output of natural gas in Indonesia was reported at 533 trillion cubic feet in

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1977, compared with 222 trillion cubic feet in 1975. A basic factor affecting the expansion of natural gas production is the success of the two large LNG projects—the Badak Field in East Kalimantan developed by Huffco and the Arun Field in North Sumatra developed by Mobil.[16] How much LNG can be sold to the United States and Japan clearly affects plant completion and production schedules. Both LNG plants are joint ventures with Pertamina.

The Badak gasfield is also a small producer of crude oil and has the potential to produce 50,000 barrels per day. The plan is to eventually produce 550 million cubic feet of natural gas per day for the local LNG plant, the first section of which was completed in late 1977. Two additional gas-processing trains were being considered for Badak. The Arun Field, near Lho'seumawe, will initially have three trains, to be completed by fall of 1978, with additional expansion contemplated. The Arun LNG plant will be rated at 1 billion cubic feet of natural gas per day; the oil and gas field supplying it might eventually also produce 100,000 barrels per day of crude oil. The Arun project calls for construction of a 16-inch gas pipeline and a 42-inch condensate pipeline over a distance of 20 kilometers. Full production from the two projects, which together may cost $2 billion, is not expected until the mid-1980's. The total foreign exchange balance of these two projects for the remainder of the 20th century may run up to $8 billion. There was some controversy regarding the U.S. west coast market in the immediate future.

Petroleum.—Indonesia's 1977 oil production, which ranked 14th in the world and constituted 2% of the world total, was up 11.8% from the approximately 1.5 million barrels per day in 1976. The bulk of this was exported as crude oil, as Indonesia's refinery capacity is not particularly large. In 1977, Indonesia produced 615 million barrels of crude oil, exported 484 million barrels, and refined 154 million barrels. About 51 million barrels of the refinery products ultimately derived was exported also. Overall oil exports netted $6.5 billion in 1977, compared with less than $6 billion in 1976. In 1977, 48% of Indonesia's crude oil exports went to Japan and 37% went to the United States.

In 1977, Caltex's share of national output was about 50%, compared with 63% in 1975. Caltex's output did not show much change, whereas lesser companies made significant advances. Caltex produces low-sulfur Minas light crude, famed the world over. Caltex, with facilities mainly near the coast in central Sumatra, produced 304 million barrels in 1977. Ranked next was Total Indonesie with 84 million barrels (nearly triple its 1976 output), followed by Union Oil with 50 million barrels, Arco with 48 million barrels, IIAPCO with 41 million barrels, Pertamina with 32 million barrels, Petromer Trend with 28 million barrels, and P.T. Stanvac Indonesia with 12 million barrels. During 1977, U.S.-affiliated companies produced about 85% of Indonesia's oil.

Pertamina's importance goes far beyond its output of roughly 5% of the country's crude oil in 1977. It owns all of Indonesia's refineries, controls the international and domestic petroleum distribution system, operates a fleet of tankers and other ships, plays a strong role in pipelines and terminals, and is involved in dozens of joint ventures and enterprises, including many nonindustrial projects. Pertamina represents the Government in foreign oil contracts and supervises international oil contractors and service companies. Pertamina's debts resulting from overspending were gradually brought under control by quick action on the part of the Government, which assumed control of its business dealings, installed new management, and reevaluated all projects.

Favorably impressed with developments, creditors and international financial agencies have worked closely with the Government in developing new repayment schedules. During fiscal year 1976-77, several private loans were obtained, including an $850 million loan arranged by Morgan Guarantee Trust and two loans totaling $200 million from Japanese banks; $1.5 billion worth of foreign credits was provided through Bank Negara Indonesia. Because of the Pertamina problem and an initial unfavorable U.S. IRS ruling affecting international investors in oil,[17] the Government started to revise the longstanding production-sharing contract system and looked for areas to net Indonesia more income. As a result, exploration activities hit rock bottom at the beginning of 1977.

Subsequently, the Government, realizing the concern it had created in renegotiating oil contracts and noting that the former IRS ruling had been reversed, took steps to provide incentives to investors to encourage renewed interest in exploration. The first actions taken in spring of 1977 were related

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to "new" oil: Oil provided to Pertamina for domestic consumption will be measured at the prevailing market price for the first 5 years of production; a tax credit of 20% of the capital investment cost for new fields may be taken by the contractor from gross production before tax deduction; and for all new oil investment schemes, the 7-year accounting method will apply. Individual incentives were also given to Caltex, Aquitaine, Shell International, and Mobil. By late 1977 and early 1978, oil exploration started to pick up. Caltex began a $78 million enhanced recovery program. IIAPCO and Arco initiated development work in their Java Sea areas and made plans to quickly install new platforms. Total Indonesie plans to bring in new production shortly and had budgeted $50 million for exploration for the coming year. Stanvac plans to sign a new regular production-sharing contract for a central Sumatra area. Additional drilling will be done in Irian Jaya. Increased exploration in 1978, however, may mean that oil production will fall below the 1977 level.

Caltex's giant Minas Field in Sumatra continued to produce at about 350,000 barrels per day in 1977, compared with 770,000 barrels per day for the company as a whole and less than 100,000 barrels per day for its second-ranking field, Bangko. However, Caltex's overall output may decline as much as 130,000 barrels per day in the coming year, based upon the prognosis of 1977. Arco's four producing structures off the northwestern coast of Java, known as the Arjuna Fields, together furnished 104,000 barrels per day. Total Indonesie's Handil Field produced 180,000 barrels per day in 1977, and its Bekapai Field produced 50,000 barrels per day. IIAPCO's large Cinta Field produced 117,000 barrels per day during the year, and Union Oil's large Attaka Field produced 115,000 barrels per day. Petromer Trend's fields on the Vogelkop Peninsula of Irian Jaya were together producing about 80,000 barrels per day in 1977, with the Walio Field scheduled to boost overall output considerably.

At yearend, Indonesia's oil-refining capacity stood at about 530,000 barrels per day. Three refineries were in the 100,000- to 110,000-barrel-per-day range—Pladju in South Sumatra, Cilacap in Central Java, and Dumai in central Sumatra. Three refineries were in the 50,000-barrel-per-day range—Sungei Gerong in South Sumatra, Balikpapan in Kalimantan, and Sungei Pakning in central Sumatra. There were two smaller refineries called P. Brandan and Wonokromo. All of Indonesia's eight refineries are run by Pertamina as State operations.

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[1]Supervisory physical scientist, Branch of Foreign Data.

[2]U.S. Embassy, Jakarta, Indonesia. State Department Airgram A-62, June 30, 1978, p. 13.

[3]Where necessary, values have been converted from Indonesian rupiahs (Rp) to U.S. dollars at the rate of Rp415 = US$1.00.

[4]Mining Journal (London). Mining Annual Review 1978. P. 457.

[5]Asia Wall Street Journal (Hong Kong). June 7, 1978, p. 3.

[6]Asia Wall Street Journal (Hong Kong). Huge Overrun in Costs Faces Asahan Project. Feb. 20, 1978, p. 1.

[7]Mining Journal (London). Apr. 14, 1978, p. 283.

[8]U.S. Embassy, Jakarta, Indonesia. State Department Airgram A-141, Dec. 9, 1977, p. 2.

[9]Modern Asia (Hong Kong). Problems Bug Indonesia's Bid to Develop Steel Industry. August 1977, pp. 31, 34-35.

[10]U.S. Embassy, Jakarta, Indonesia. Mining, Petroleum, and Natural Gas—Market Review. State Department Airgram A-42, May 15, 1978, pp. 15-16.

[11]Asia Wall Street Journal (Hong Kong). Nov. 4, 1977, p. 3.

[12]Asia Mining (Manila). World's Largest Tin Dredger. November 1977, pp. 39-41.

[13]Page 63 of work cited in footnote 10.

[14]Asia Wall Street Journal (Hong Kong). May 23, 1978, p. 9.

[15]Asia Wall Street Journal (Hong Kong). May 26, 1978, p. 3.

[16]Pages 44-45 of work cited in footnote 10.

[17]In production-sharing contracts, the share retained by Pertamina was initially judged to be a royalty and therefore not eligible for a foreign tax credit in the United States.

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The Mineral Industry of Iran

By Janice L. W. Jolly[1]

Iran's mineral production contributed approximately 38% of the Iranian year 1977[2] gross national product (GNP) of $75.3 billion[3] at current prices. Iran's economy continued to reflect the effects of the post-1973 oil boom, but the level of activity was lower as oil exports and domestic investment declined. Real GNP growth for Iranian year 1977 at constant 1974 prices was 0.9%, compared with 11.1% in Iranian year 1976. High inflationary rates were eroding growth and discouraging domestic investment. Static oil receipts and the consequent loss of purchasing power were negative factors in the country's growth. Nevertheless, expansions were planned and were well underway for the copper, aluminum, iron and steel, lead-zinc, cement, and natural gas industries.

Iran's sixth development plan (1979-83) was not yet available, but it was reportedly related to a 20-year national objectives scheme of which it was the first 5-year segment. Sector growths projected through 1983 were 27.2% for the oil and gas industries and 24.7% for mines and other industry.

Foreign investment in Iran was apparently increasing. Stimulating factors included the increasing market size and the necessity to produce inside Iran's protective walls. Relative political stability was also a criterion. The estimated value of all private foreign equity investment in Iran by August 1977 was $1.8 billion, to which the United States had contributed $700 million. Japanese investment in petrochemicals was expected to vastly increase this value in the near future.

PRODUCTION AND TRADE

The estimated mineral production value for Iranian year 1977 (based on average world prices) was $450 million, excluding petroleum products, natural gas, and clays. Mineral production included cement ($128 million), coal ($63 million), zinc ($53 million), chromite ($32 million), iron ore ($31.5 million), lead ($27 million), copper ($7.8 million), barite ($5.4 million), turquoise ($1.3 million), and gypsum ($33,000). Aluminum produced from imported alumina was estimated at $48 million. Crude petroleum production for Iranian year 1977 was valued at approximately $21 billion, natural gas production at an estimated $650 million, and petrochemicals production at an estimated $900 million.

Total nonpetroleum exports (which includes natural gas) were valued at $703 million for Iranian year 1976. Mineral ore exports, forming 2.8% of the total, were valued at $20 million, a decrease of 36% from those of Iranian year 1975. Exports of iron and steel products, on the other hand, increased 200% and were valued at $15 million.[4] Total nonpetroleum exports for Iranian year 1977 were valued at $524 million. Gas delivered by way of the IGAT-II pipeline to the U.S.S.R., valued at $195 million, accounted for 30% of the total gas produced for consumption in Iranian year 1977. An agreement was signed between the U.S.S.R. and Iran to increase natural gas deliveries 30%.

During Iranian year 1977, Iran exported 1.8 billion barrels of crude oil. Of this total, the Oil Service Co. of Iran (OSCO) trading companies exported 1.2 billion barrels (down 17.1%). National Iranian Oil Co. (NIOC) direct exports were 414.5 million barrels (up 32.5%), and NIOC joint venture exports were 196 million barrels (up 17.8%). During Iranian year 1977, 77,240,000 barrels of crude (down 0.2%) was delivered to

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the Abadan refinery for refining and subsequent export by OSCO. NIOC exported about 7,838,200 barrels of refined products in the period August through December 1977.

The posted price for Iranian crude oil was $13.77 per barrel for 34° API gravity crude and $13.43 per barrel for 31° API gravity crude in January 1977.[5] Demand for Iranian heavy crude remained low, and the price was cut 9.5 cents per barrel at midyear. Major importers of Iranian crude were Japan (17%), Carribean and West Indies countries (12%), the Netherlands (8%), the United States (8%), and the Republic of South Africa (6%).

Table 1.—Iran: Production of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity[2]	1975	1976	1977[p]
METALS			
Aluminum, primary ingot	51,000	30,600	21,100
Chromium: Chromite, gross weight	210,116	160,000	233,300
Copper:			
Mine output, metal content	3,750	r e6,000	e13,500
Smelter[e]	4,000	4,000	7,000
Refined[e]	7,000	7,000	7,000
Iron and steel:			
Iron ore, gross weight thousand tons	1,019	1,100	1,100
Metal:			
Pig iron do	e1,000	625	e700
Steel, crude do	551	550	e550
Lead:			
Mine output, metal content	33,600	35,000	40,000
Smelter[e]	300	300	300
Manganese ore, gross weight	36,000	40,000	40,000
Zinc, mine output, metal content	50,600	72,000	61,500
NONMETALS			
Barite	200,000	230,000	184,650
Cement, hydraulic thousand tons	5,400	6,100	7,256
Clays:			
Bentonite[e]	50,000	50,000	23,400
Fire clay	NA	NA	72,201
Kaolin	160,000	200,000	111,202
Feldspar	NA	NA	3,000
Fertilizer materials:			
Manufactured:			
Nitrogenous	NA	261,000	e265,000
Phosphatic	NA	250,000	e250,000
Other, including mixed	NA	50,000	NA
Ammonia	374,000	NA	240,000
Gem stones: Turquoise, crude	65	e70	82
Gypsum thousand tons	5,000	4,100	7,500
Lime[e] do	1,000	1,000	1,000
Magnesite	4,000	5,000	5,000
Pigments, mineral, natural	r6,000	4,588	3,500
Salt, rock thousand tons	691	700	700
Sodium compounds: Caustic soda	NA	18,000	NA
Stone, sand and gravel:			
Limestone thousand tons	8,000	e8,000	e8,000
Marble do	225	320	397
Silica do	300	300	300
Travertine do	215	400	200
Other do	NA	18,000	NA
Strontium minerals: Celestite[e]	300	200	200
Sulfates, natural:			
Aluminum-potassium sulfate (alum)	43,000	NA	8,500
Sodium sulfate (mineral not specified)[e]	25,000	25,000	40,000
Sulfur:			
Native thousand tons	e20	188	e188
Sulfuric acid do	NA	260	e260
Byproduct of petroleum and natural gas do	475	399	e400
Talc	NA	NA	400
MINERAL FUELS AND RELATED MATERIALS			
Coal thousand tons	930	1,000	969
Coke do	540	444	e444
Gas, natural:			
Gross million cubic feet	1,603,384	1,776,225	2,059,504
Marketed do	771,057	793,739	e795,000
Natural gas liquids:			
Propane thousand 42-gallon barrels	3,290	3,170	4,625
Butane do	3,705	3,673	4,447
Natural gasoline and other do	5,031	5,283	6,798
Total do	12,026	12,126	15,870

See footnotes at end of table.

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Table 1.—Iran: Production of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity[2]		1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS —Continued				
Petroleum:				
Crude[3]	thousand 42-gallon barrels	1,952,650	2,168,237	2,080,051
Refinery products:				
Gasoline:				
Aviation	do.	4,123	3,166	2,619
Motor	do.	26,389	29,474	32,243
Jet fuel	do.	12,520	8,857	11,995
Kerosine	do.	27,003	32,815	34,425
Distillate fuel oil	do.	44,885	49,629	56,960
Residual fuel oil	do.	101,243	96,072	102,920
Lubricants	do.	2,495	824	2,760
Other:				
Liquefied petroleum gas	do.	3,661	4,184	4,629
Naphtha and solvents	do.	8,485	5,289	7,430
Asphalt	do.	4,523	5,215	NA
Bitumen	do.	NA	NA	5,971
Unspecified	do.	1,048	3,075	604
Refinery fuel and losses	do.	11,201	16,783	11,483
Total	do.	247,576	255,383	274,039

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]Data are for the Iranian calendar year, which is the year beginning March 21 of that stated, except data for natural gas, natural gas liquids, and petroleum, which are for regular calendar years.

[2]In addition to the commodities listed, other types of crude construction materials (such as common clays, sand and gravel, and other varieties of stone) are also produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[3]Excludes petroleum produced and reinjected into fields.

Table 2.—Iran: Exports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal including alloys, all forms	[r]15,545	1,508	Japan 1,506.
Arsenic, natural sulfides	4	5	All to Bahrain.
Chromium: Chromite, 48% Cr_2O_3	77,078	5,400	Yugoslavia 5.
Copper:			
Ore and concentrate	8,700	4,200	All to Japan.
Metal including alloys	[r]3	6	Saudi Arabia 5.
Iron and steel:			
Ore and concentrate	220	214	Sweden 144; Iraq 70.
Metal:			
Pig iron, ferroalloys, similar materials	85	161	Iraq 150.
Semimanufactures	3,600	1,563	Saudi Arabia 833; Hungary 316; Kuwait 181; Afghanistan 161.
Lead:			
Ore and concentrate	82,382	4,444	Mainly to U.S.S.R.
Metal including alloys, all forms	7	--	
Silver waste and sweepings, troy ounces	6,559	31,893	Libya 27,617; United States 4,276.
Zinc ore and concentrate	63,308	32,765	U.S.S.R. 14,515; Poland 10,000.
Other ores and concentrates	[r]1,000	--	
NONMETALS			
Abrasives, natural:			
Crude, n.e.s.	--	600	All to Kuwait.
Grinding and polishing wheels and stones	[r]26	676	Kuwait 442; Romania 220.
Cement	1,169	--	
Chalk	20	40	Afghanistan 20; Greece 20.
Clays and clay products:			
Crude:			
Kaolin	(2)	10	Italy 9; West Germany 1.
Fuller's earth	9	4	All to Bahrain.
Fire clay	3	--	
Drilling mud	10	--	
Other	[r]2	1	Mainly to India.
Products:			
Refractory	39	10	All to Kuwait.
Nonrefractory	[r]31	687	U.S.S.R. 588; Bahrain 96.
Diamond, value	$29,949	--	
Fertilizer materials:			
Manufactured:			
Potassic	[r]354	21	All to Kuwait.
Other	2,962	3,075	Kuwait 1,860; Abu Dhabi 604; Oman 484.
Ammonia	67,195	9,151	Mainly to United States.

See footnotes at end of table.

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Table 2.—Iran: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Graphite, natural	180	380	Mainly to Italy.
Gypsum	r1,942	176	Oman 147; Switzerland 20.
Lime	689	1	All to Bahrain.
Pigments, mineral, natural, including processed iron oxides	r204	100	Mainly to Iraq.
Precious and semiprecious stones, except diamond value	$1,006,609	$254,442	United States $244,354.
Salt	1,975	1,603	Oman 466; Qatar 383; Bahrain 376; Kuwait 315.
Stone, sand and gravel:			
Dimension:			
Crude and partly worked:			
Calcareous	19,791	14,637	Italy 8,302; Netherlands 4,064; Spain 1,016.
Slate	--	17,650	Japan 12,700; Bénin 3,350; Netherlands 1,600.
Worked:			
Slate	21	660	Kuwait 440; Romania 220.
Paving stone and flagstone	564	10	All to Austria.
Other	346	258	Bahrain 97; Qatar 89; Oman 72.
Dolomite	540	--	
Gravel and crushed stone	39,065	17,082	Kuwait 7,845; Oman 7,200; Saudi Arabia 1,600.
Sand, excluding metal bearing	3	--	
Sulfur:			
Elemental:			
Colloidal	43,323	287,346	Japan 137,611; India 77,729; Australia 27,746.
Other than colloidal	r21,933	30,971	India 30,950.
Sulfuric acid	--	1	All to Saudi Arabia.
Other, crude	r1	5,011	All to U.S.S.R.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	r2,009	983	Mainly to Asia.
Coal, all grades, including briquets	22,245	337	All to Kuwait.
Petroleum:[3]			
Crude and partly refined thousand 42-gallon barrels	1,225,732	901,725	Europe 456,695; Asia 265,401; United States 104,969.
Refinery products:			
Gasoline do	53,132	12,993	Asia 6,662; Africa 2,891; Europe 1,609; Australia 1,311.
Kerosine do	3,661	1,716	Asia 721; Africa 538; Australia 232.
Distillate fuel oil do	29,401	12,661	Asia 6,251; Europe 4,570.
Residual fuel oil do	5,772	46,124	Europe 23,796; Asia 15,416.
Lubricants do	16	4	Mainly to Asia.
Other:			
Liquefied petroleum gas do	9,797	5,755	Asia 5,254.
Mineral jelly and wax do	(4)	(4)	All to Asia.
Bitumen and other residues do	r(4)	--	
Bituminous mixtures do	r(4)	--	
Petroleum coke do	--	1	Do.
Total do	r101,779	79,254	

rRevised.
[1]Data are for the Iranian calendar year, which is the year beginning March 21 of that stated.
[2]Revised to none.
[3]Destinations of shipments reported by continent only in most cases; detail by country not available except as shown.
[4]Less than 1/2 unit.

Table 3.—Iran: Imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum:		
Bauxite ore and concentrate	20	122
Oxide and hydroxide	72,084	58,323
Metal including alloys:		
Unwrought	r5,222	9,543
Semimanufactures	18,465	17,931
Arsenic trioxide, pentoxide, acids	40	66
Beryllium metal including alloys, all forms	12	55
Chromium oxide and hydroxide	81	303
Cobalt oxide and hydroxide	28	79

See footnotes at end of table.

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Table 3.—Iran: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS —Continued			
Copper:			
Matte		498	3
Metal including alloys:			
Scrap		2,676	2,497
Unwrought:			
Refined, unalloyed		151	1
Master alloys		484	871
Semimanufactures		31,570	36,976
Gold metal, all forms	thousand troy ounces	1,041	3,068
Iron and steel:			
Ore and concentrate		12	(2)
Metal:			
Scrap		7,238	502
Cast iron		6,194	9,809
Ferroalloys		r13,350	13,945
Steel, primary forms		507,396	272,264
Semimanufactures	thousand tons	r2,963	3,681
Lead:			
Oxide		1,441	129
Metal including alloys:			
Scrap		12	95
Unwrought		602	1,001
Semimanufactures		532	340
Magnesium metal including alloys, all forms		r331	394
Manganese:			
Ore and concentrate		86	--
Oxide		2,443	3,820
Mercury	76-pound flasks	r5,640	656
Molybdenum metal including alloys, all forms		2	(2)
Nickel metal including alloys:			
Scrap		30	4
Unwrought		r174	72
Semimanufactures		355	284
Platinum metal, including scrap, waste, ash	value, thousands	$252	$62
Silver metal, including scrap, waste, ash	thousand troy ounces	1,273	2,081
Tin:			
Oxide		27	18
Metal including alloys:			
Scrap		21	5
Unwrought		357	602
Semimanufactures		280	9,660
Titanium oxide		r447	429
Tungsten metal including alloys, all forms		16	33
Uranium and thorium metals including alloys, all forms	kilograms	--	73
Zinc:			
Oxides		892	1,786
Metal including alloys:			
Scrap		50	14
Unwrought		8,071	5,505
Semimanufactures		1,071	505
Other:			
Ores and concentrates:			
Of molybdenum, tantalum, titanium, vanadium, zirconium		1,150	2,331
Of base metals, n.e.s		r2	8
Ash and residue containing nonferrous metals		130	65
Metals including alloys, all forms:			
Alkali, alkaline earth, rare-earth metals		167	35
Base metals including alloys, all forms, n.e.s		332	288
NONMETALS			
Abrasives, natural:			
Crude, n.e.s		152	29,824
Grinding and polishing wheels and stones		1,220	727
Asbestos		24,814	40,109
Barite		r797	205
Boron materials:			
Crude natural borates		20	--
Oxide and acid		412	545
Cement		1,229,807	1,375,380
Chalk		4,183	4,414
Clays and clay products (including all refractory brick):			
Crude:			
Fire clay		9,271	4,108
Kaolin		18,848	22,663
Drilling mud		14,241	10,242
Kyanite and sillimanite		534	2,557
Products:			
Refractory (including nonclay brick)		48,127	90,839
Nonrefractory		r7,129	17,291
Cryolite and chiolite		1,903	1,535
Diamond, all grades	value	$160,790	$578,373
Diatomite and other infusorial earth		979	1,481
Feldspar and fluorspar		1,972	2,224

See footnotes at end of table.

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Table 3.—Iran: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS —Continued			
Fertilizer materials:			
Crude:			
Phosphatic		61	73
Other		r2,472	3,471
Manufactured:			
Nitrogenous		r178,000	22,560
Phosphatic, including Thomas slag		240,421	101,938
Potassic		r2,024	48
Other, including mixed		r96	93
Ammonia		66	384
Fluorine, elemental		620	5
Graphite, natural		2,522	756
Gypsum and plasters		1,546	1,275
Iodine and bromine		2,694	255
Lime		722	106
Magnesite		535	1,501
Mica:			
Crude		2,733	2,291
Worked		26	3,257
Pigments, mineral:			
Natural, crude		22	357
Iron oxides, processed		r525	838
Precious and semiprecious stones, except diamond:			
Natural	value	r$283,692	$515,094
Manufactured	do	$196,992	$500,366
Salt		283	28
Sodium and potassium compounds, n.e.s.:			
Caustic soda		6,674	17,208
Caustic potash		r177	298
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Slate		50	208
Other		182	2,980
Worked:			
Slate		35	5
Other		130	47
Dolomite		94	20
Gravel and crushed stone		1,083	174
Limestone, except dimension		253	178
Quartz and quartzite		1,228	3,746
Sand, excluding metal bearing		14,333	16,072
Sulfur:			
Elemental, all forms		422	744
Sulfuric acid		68	92
Sulfur dioxide		37	64
Talc, steatite, soapstone, pyrophyllite		r193	327
Other:			
Crude		167	533
Slag, dross, and similar waste, not metal bearing		45	4
Oxides and hydroxides of magnesium, strontium, barium		306	322
Unspecified		91	172
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		269	227
Carbon black and gas carbon		r1,994	982
Coal and coke, including briquets		r2,308	5,142
Hydrogen and other rare gases		558	1,079
Peat, including peat litter		5	(2)
Petroleum:			
Crude and partly refined	42-gallon barrels	151	741,196
Refinery products:			
Gasoline	do	--	119
Kerosine and jet fuel	do	8	--
Distillate fuel oil	do	r30	3,059
Residual fuel oil	do	--	7
Lubricants	do	r59,613	150,162
Mineral jelly and wax	do	r11,609	38,264
Other:			
Nonlubricating oils, n.e.s.	do	10,038	3,990
Liquefied petroleum gas	do	r1,155	2,282
Pitch	do	47,960	18,271
Pitch coke	do	6,694	(3)
Petroleum coke	do	264	77
Bitumen and other residues	do	9,060	5,939
Bituminous mixtures	do	10,066	16,689
Total	do	r156,497	238,859
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		19,671	12,996

rRevised.

[1]Data are for the Iranian calendar year, which is the year beginning March 21 of that stated.

[2]Less than 1/2 unit. [3]Value only reported at $1,940.

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COMMODITY REVIEW

METALS

Aluminum.—Iran had no known commercial bauxite deposits and was therefore pursuing a course that included importing alumina for domestic processing, investigating the use of extensive domestic alunite deposits, and assisting in the development of nearby foreign bauxite deposits such as those in India. The current demand for alumina was about 90,000 tons per year; this was expected to rise to 950,000 tons by 1988.

Iranian Aluminium Co. (Iralco) was a joint venture between the Iranian Government Industrial Development and Renovation Organization (IDRO) (82.5%), the Pakistani Government (5%), and Reynolds International (12.5%). Construction of the plant at Arak was completed in 1973. Alumina was imported from Australia and India for use in the Iralco plant. The alumina was bulk-delivered by ship to Bandar-e Shahpur, where it was transferred into special 50-ton railcars for the 650-kilometer trip to Arak. Electric power was the most important initial consideration for situating the alumina plant at Arak. Hydroelectric power was available from the Reza Shah Dam, located 300 kilometers away, and later gas was piped in. In Iranian year 1976, however, the Arak plant produced at only 84% of capacity because of an electric power deficiency. The capacity of the smelter was being expanded to 125,000 tons per year by 1980, but this was dependent upon the availability of additional sources of energy to be furnished by gaslines under construction.

An agreement with Aluminum Co. of Canada Ltd. (Alcan) was signed on May 19, 1977, for the construction of a second aluminum smelter at Bandar 'Abbas. Alcan was awarded a $2.5 million contract to undertake the feasibility study for the new smelter. Iran's alunite deposits, estimated at 1 billion tons at Takestan in East Azerbaijan Province, were under consideration, but alumina from foreign sources would most likely be used for the new plant.

As a potential source of alumina for Iran's expanding aluminum industry, a trade protocol was signed with India for the development of bauxite in Andhra Pradesh and Orissa States of India. Extensive bauxite reserves had been located, and the Indians were looking for foreign partners to establish alumina plants in the area.[6]

It was reported that Iran and the U.S.S.R. had signed an agreement for a $600 million alumina plant in Tehran with an initial 500,000-ton annual capacity and a provision to double this figure. A study was being undertaken to determine the feasibility of using alunite for this plant.

Chromite.—In 1977, chromite was being produced from mines in three districts. In the northeastern Froumad District, Froumad Chromite Mining Co., owned 51% by Iran Mining and Metallurgical Co. (IMMC), was operating the Gaft mine. In the Esfandagheh District of southern Iran, the Abdasht and Bahborj mines were operated by Esfandagheh Mining Co., owned by IMMC (2%), Resai Bros. and other private Iranian interests, and British Engineer and Planning Resources Corp. The Amir and Shahriar Shahin mines of the Fariab District near Minab were the largest producers and were being operated by Fariab Co., owned by the Shahriar Industrial Group and Philipp Bros. (Canada) Ltd. Approximately 233,300 tons of chromite was produced in Iranian year 1977.[7]

Copper.—Copper reserves in active mines were estimated at over 1 billion tons, including new reserves added at Sar Cheshmeh through deep drilling in the open pit[8] (bringing the total to 850 million tons of 1.2% copper) and at the mine at Qal'eh Zari (adding 200 million tons of 3% to 4% copper). Estimated reserves at several smaller mines included 300,000 tons at Mazra'eh, located west of Razan; 100,000 tons at Baychebagh, located west of Mīaneh; and 200,000 tons at Chiezeh, located south of Rasht.

Mining at the Qal'eh Zari mine began in 1975 by Minak Co., a Japanese-Iranian joint venture of Toho Zinc Co., Ltd., Ataoka Sangya, and the private Iranian firm Sherkat Sahami Maaden Loute. The mine, located south of Birjand in southern Khorāsān Province, was being mined by underground methods. The entire production of about 14,000 tons per year of 30% copper concentrate was being exported to Japan.

Copper ore was being stockpiled at Sar Cheshmeh awaiting completion of the concentrator and smelter complexes. Concentrator production was expected to start in August 1978 and smelter production soon thereafter. Construction of the related township, known as New City, was far behind, plagued by a shortage of skilled labor. Concentrator capacity was to be

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40,000 tons per day of ore with a head grade of 1.2% copper. The following equipment was included in the crushing and grinding sections: Primary crushing—a Fuller 10.5-foot gyratory crusher of 4,200-ton-per-hour capacity; secondary crushing—three Nordberg standard-cone crushers; tertiary crushing—six Nordberg shorthead-cone crushers; and wet grinding—eight 8-meter-long by 5-meter-diameter ball mills.

National Iranian Copper Industries Co. awarded Krupp Industrie- und Stahlbau of the Federal Republic of Germany and Mechim of Belgium contracts totaling $143 million for engineering and procurement at Sar Cheshmeh. Krupp and Mechim hold 45% and 55%, respectively, in the consortium. Mechim was to undertake technical coordination and Krupp was to be overall manager for the project. The contracts included a copper refinery with an annual capacity of 158,000 tons of electrolytic copper, a nickel sulfate plant, and a facility for recovering various precious metals. Construction under the Krupp-Mechim contracts was to begin in early 1978, and the complex was expected to come onstream in 1981. Until the refinery starts up, all copper was to be exported to European refineries. The total cost of the Sar Cheshmeh mine and processing plant was put at $1.12 billion, and the township and related facilities were estimated at another $2.3 billion. By-product molybdenum was expected to add another $100 million to $150 million of earnings per year, based on a full production of 3,000 tons. The Anaconda Company (United States) technical service and consulting contract signed in 1974 was to last 10 years.

The Iranian Geological Survey was undertaking a 3-year, $29 million exploration program along the Iranian copperbelt that extends through Baluchestan, Kermān, and Yazd Provinces. New copper mines were under development at Meiduk near Kermān, and deposits located at Chehelkareh in the Zahedan area of Baluchestan Province were being explored by Minak.

Gold.—Approximately 100,000 tons of gold ore had been mined at the Muteh gold mine and was ready for further processing. Production had been suspended since 1972. IMMC signed an agreement with IDRO to establish a gold-casting factory. IMMC was to build a 200-ton-per-day concentrator and a cyanide plant at the Muteh mine, located south of Qom. Further exploitation of the Muteh gold-pyrite-quartz vein deposit was included in the fifth development plan objectives. Reserves were estimated at 500,000 tons averaging 0.2 troy ounce of gold per ton, with probable reserves of 2 million tons.[9] Exploration was being carried out around the Muteh mine and throughout the district. There were approximately 50 other gold-bearing properties for which further detailed exploration was planned.

Iron Ore.—Iron ore was produced by National Iranian Steel Corp. (NISC) from the Choghart deposit located in the Bafq District west of Yazd. The Bafq District was estimated to have nearly 600 million tons of magnetite-hematite reserves with up to 65% iron distributed in several deposits. This included 170 million tons at the Choghart deposit, 150 million tons at the Northern Anomaly, 150 million tons at Anomaly XI, and 100 million tons at the Chadar Malu deposit. All of these deposits were scheduled for further development. Ore from the Choghart deposit was used to supply the Aryamehr steel plant at Isfahan, which was also operated by NISC.

Reserves at the Gol-e-Gowar iron ore deposit located in the Kermān area were estimated at 400 million tons with 60% iron and a comparatively low phosphate and sulfur content. This mine was being developed by National Iranian Steel Industries Co. (NISIC) and Grängesberg Industriavaru AB of Sweden. Production from Gol-e-Gowar was expected to reach 5 million tons per year by 1980. Also slated for development by NISIC under the sixth development plan were the iron ore deposits at Tangezagh, 150 kilometers south of Gol-e-Gowar near Bandar 'Abbas, estimated to contain 60 million tons of 56% to 62% iron.

The Arak District in west-central Iran also had several deposits of iron ore, the largest of which was at Shamsabad with an estimated 100 million tons of limonite-hematite ore averaging 43% iron. There were no announced plans to develop these deposits. Total resources of iron ore in Iran were estimated at about 1.6 billion tons.

Iran was financing the development of the Kudremudkh iron ore deposit in India. Of the total $630 million Iranian loan, $450 million was to be spent on the mine and processing plant, $90 million for a mineral port at Mangalore, $70 million for power facilities, and $20 million for townsites. Iran was to import much of this ore for use in its steel mills.

Iron and Steel.—Iran expected to produce 6.7 million tons of steel by 1982. This was somewhat below the expectations of the fifth development plan, which had a goal of 10 million tons of steel to be produced by the end of the plan period in 1978. To

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achieve this, the Government embarked on a program of expansion that included new mills using direct-reduction. The Soviet-built NISC steel mill at Isfahan used conventional technology. Most of the direct-reduction plant projects, which will utilize abundant local natural gas resources, were to be built and operated by the Government organization NISIC. Three of the seven planned steel mill projects were expected to be producing by 1983. These plants were to be located at Ahwaz, Bandar 'Abbas, and Isfahan and were expected to consume about 5.2 million cubic meters of gas per year. Iran's steel consumption was expected to reach 6 million tons by 1978, and predictions were that consumption would reach 12 million tons by 1982.

The first steel mill project completed by NISIC started production in mid-January 1978. This was the first unit (Purofer plant) of the Pahlavi steel complex at Ahwaz. The Ahwaz steel complex was to have a capacity of 2.8 million tons of steel per year and was to have three direct-reduction mills, each with a different process. One mill with a 1.2-million-ton-per-year capacity was to use the Midrex method; another with a 1-million-ton-per-year capacity was to use the HyL method of Pullman Swindell Corp. of the United States; and the third with a 400,000-ton-per-year capacity was using the Purofer method suppled by Thyssen Rohrenwerke A.G. The total investment at Ahwaz was estimated at $800 million. A trial operation of the prototype Purofer process began in early 1977. The plant produced 30,000 tons of sponge iron briquets in its first month.

In early 1977, the basic design work for the Bandar 'Abbas steel plant was completed. Costruzioni Metalliche Finsider S.p.A. (Italy) was to direct the completion of this NISIC project, which would consist of direct-reduction furnaces with a total capacity of 3 million tons per year and would cost about $3 billion to construct. Finsider was to provide 20% and NISIC the balance of the $100 million initial capital for Bandar 'Abbas Rolling Mill Co. Terms also involved an oil barter deal, which was used to finance about 60% of the project. Construction on the complex was to begin in 1982. The NISIC steel project at Isfahan was to have an annual capacity of 1.2 million tons of sponge iron.

NISC's Aryamehr steel mill at Isfahan was producing 600,000 tons per year of various steel products. Expansion was underway to raise capacity to 1.9 million tons by the end of 1978. The plant's capacity was planned to eventually reach 6 million tons per year.

Lead and Zinc.—Approximately 37 lead-zinc mines were operating in Iran. The largest zinc producers were the Angouran mine, operated by Sherkat Sahami Calcimin, with 18% of total production; the Kushk mine, operated by Bafq Mining Co., with 12% of total production; and the Shahkuh mine, operated by Bama Private Co., with 7% of total production. Both the Angouran and Kushk mines were owned by Soc. Industrielle et Minière Iranienne (SIMIRAN), a private Iranian company that also owned the Ardokan and Shah-Ali Baglou lead-zinc mines. Construction of the concentrator at Angouran was completed in 1977, and the mill had a capacity of 2,000 tons of ore per day. The Kushk mine was being expanded to 40,000 tons per year of zinc ore and 10,000 tons per year of lead ore. Bama had contracted a Swedish group to complete electrical installation for two concentrating plants. Production from the first plant had already started. A crusher station, dense-media separation station, and flotation plant were included. Total capacity at the Shahkuh mine was expected to be 1 million tons per year of lead-zinc ore at the end of 1977.

Significant lead producers included the Ravandje mine, operated by Sogemiran S.A. (a subsidiary of Soc. Générale des Minerais S.A. of Belgium); the Nakhaluk mine, operated by IMMC; and the Mehdiabad mine, operated by Mehdiabad Mining Co. (a joint venture of Meshahr Mining Co. and AMAX Inc.). The Ahangaran open pit lead-zinc-pyrite mine located west of Arak near Malayer was operated by Sormak Mining Co. (a private Iranian firm). This mine had reserves indicated at 1 million tons of 10% lead, both as sulfide and carbonate. The concentrate was being sent to the U.S.S.R. for further processing. By early 1977, the mine was producing 300 tons per day of ore, which resulted in 30 tons per day of 50% lead concentrate.

Ore reserves reported for Mehdiabad, located south of Bafq, were 24 million tons of lead-zinc ore with some copper and silver. Also located near Bafq, the Kushk mine was estimated to have 10 million tons of lead-zinc ore. Shahkuh, located near Isfahan, had 6 million tons of lead-zinc reserves, and Angouran, located west of Rasht, had reserves of 6 million tons of zinc-lead ore.

Uranium.—Iran had budgeted $300 million for a 10-year exploration program for uranium as part of a program geared to expanding alternative means of energy production. A Peko-Wallsend Group member, Austirex Aerial Surveys, was to explore northwestern and eastern Iran in an air-

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borne geophysical survey under a contract awarded by the Atomic Energy Organization of Iran (AEOI). The survey was to cover 290,000 square kilometers. A reconnaissance study was also to be made in the Makran and Zagros regions. Representatives of the U.S. Energy Research and Development Administration (ERDA) and AEOI were to meet periodically to discuss the Iranian exploration program. ERDA was to give short periods of training and provide advice on various technical aspects of the exploration program. Government geologists of the Federal Republic of Germany were also to aid in the development of uranium and thorium research and exploration.

The AEOI lost its mandate to plan, construct, and operate nuclear power reactors after the Iranian Parliament voted to expand the Ministry of Energy's charter to include these responsibilities. All activities related to nuclear power reactors were to be transferred to the Ministry of Energy.

Iran had plans to install 23,000 megawatts of nuclear power capacity within a 20-year period. To date, four plants with a combined capacity of 4,200 megawatts had been ordered and were under construction. Kraftwerk Union A.G. (KWU) was building two powerplants at Büshehr costing $3.3 billion. Iran was to exchange $270 million in crude oil for the two reactors. A Japanese group was providing the two water desalination units that were to be constructed next to the reactors. Électricité de France (EdF) was to install two 960-megawatt reactors on the Kārūn River near Ahwaz at a cost of over $2 billion. Negotiations for additional plants from these two countries and the United States were underway. Late in 1977, a letter of intent was signed with KWU for four nuclear plants including two at Isfahan and two at a site between Isfahan and Lake Rezaieh near the Turkish border.[10] Iran and the United States signed an agreement to share technical information related to nuclear safety and protection of the environment in April 1977. The United States was to provide two nuclear energy safety advisors through the U.S. Nuclear Regulatory Commission (NRC).

NONMETALS

Asbestos.—A major asbestos deposit was identified in southeastern Iran, 275 kilometers northwest of Zahedan.[11] Exploratory drilling was being carried out.

Barite.—Although there were a number of small deposits of barite in Iran and some byproduct production from lead-zinc mining, the bulk of the milled material was being produced by three companies. The privately owned Iran Barite Co. produces about 100,000 tons per year of barite, along with some lead, zinc, pyrite, and bentonite, from operations at the Semnān mine. Sherkat Sahami Magcobar Iran (a joint venture of Dresser Magcobar Corp. of the United States and SIMIRAN) mines barite from several underground operations at Keraj (35,000 tons per year), Vardeh (40,000 tons per year), Nobaran (20,000 tons per year), and Siahkuh (15,000 tons per year). Processing was being done at Parandak, where additional capacity was recently installed. Magcobar Iran was also hiring exploration geologists for an extensive industrial exploration program. Doreen-Imco Co. was recently formed to mine barite as a joint venture between Imco Services (U.K.) Ltd., a division of the U.S. firm Halliburton Co., and an Iranian mining company. Doreen-Imco was to operate a mine and grinding facilities near Keshan. A production capacity of 110,000 tons per year began in late 1977. The company employed 55 Iranian workers in the mine and plant.

Cement.—Cement was being produced by 12 plants in 1977, and 14 more were either planned or under construction. Cement production was expected to reach 20 million tons by 1980. Annual capacities of the operating plants were as follows: Tehran, 2,340,000 tons; Abyek (or Qazvin), 2,100,000 tons; Doroud, 1,350,000 tons; Shiraz (or Fars), 900,000 tons; Suffian, 800,000 tons; Loshan (or Sefid Rud), 720,000 tons; Kermān, 700,000 tons; Isfahan, 650,000 tons; Meshed, 560,000 tons; Rey, 150,000 tons; Ghani Abad, 100,000 tons; and Djadjerud, 30,000 tons. Plants with the following annual capacities were under construction: Isfahan (or Aryamehr), 2,000,000 tons; Behbehan, 800,000 tons; Tabrīz, 800,000 tons; Māzandarān, 720,000 tons; Kermānshāh, 660,000 tons; and Gorgan (or Neka), 600,000 tons. In addition, IDRO was planning to build cement plants with the following annual capacities: Bandar 'Abbas, Chak Behar, Kashan, and Reza'iyeh, each 720,000 tons; Hamadan, 700,000 tons; and Sanandaj, Yazd, and Zahedan, each 360,000 tons.

Production of cement amounted to about 6.1 million tons compared with a demand of around 7 million tons for Iranian year 1976. It was anticipated that the majority of new plants will start operation in the next 2 years. The Blue Circle Group of the United Kingdom was awarded the contract for design and supervision of the $91.3 million

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cement plant at Hamadān. Construction was to begin in early 1979. The cement plant at Suffian was being expanded to 3,600 tons per day (1.3 million tons per year). In 2 1/2 years, the Suffian plant is to add another 2,000-ton-per-day unit.

Clays.—Two companies account for most of Iran's bentonite production. Iran Barite produces 30,000 tons per year of bentonite and other clays from mines at Hehrejan, Semnān, and Zarrin. Magcobar Iran produces 15,000 tons per year from the Grimonj deposits.

Fertilizer Materials.—*Phosphate Rock.*—The French Bureau de Recherches Géologiques et Minières (BRGM) signed a contract with the Iranian Government for phosphate exploration in 80,000 square kilometers on the border of the Persian Gulf in Khorāsān Province.[13]

Stone.—*Limestone.*—Limestone for use in the sintering plant at the Aryamehr steel mill came from Pirbakran (Isfahan Province). About 65,000 tons of limestone was produced for use at the Aryamehr steel refractory plant.

MINERAL FUELS

Coal.—The Aryamehr coke-oven and byproducts facility at Isfahan consisted of six plants, including a coal-handling plant, a coke-oven battery, a byproduct sulfuric acid plant, a benzol distillation plant, and a coke test station. The main function of the coke-oven facility was to produce coke for use in NISC's Ayramehr steel plant blast furnace. The coke was also used as fuel in the sintering foundry, in various chemical industries, and in the production of various nonferrous metals. Coke gas was also produced and used to heat the coke-oven battery and as fuel in most steel plant shops. Coal was supplied from local mines operated by NISC, such as the Shāhrūd, Sanghroud, and Zirab mines in the Alborz region and the Pabdedana and Babnizoo mines in Kermān Province. Production of dry coke was estimated at 444,000 tons in Iranian year 1977. Proved coal reserves were estimated at 600 million tons and probable resources at as much as 25 billion tons.[13]

Natural Gas.—Included in the $8 billion, 5-year Government budget for natural gas development by the 1980's was the second gasline, IGAT-II, to the U.S.S.R. and a third gasline to western Iran. Iran was planning to extinguish all gas flares by 1980. Plans also included development of several gasfields, including the Pars and Khangiran gasfields, with as many as 180 wells for gas injection, expansion of natural gas liquids (NGL) facilities, and construction of new liquefied natural gas (LNG) projects. Assuming completion of current projects, Iran was expected to have an export capacity of about 67 million cubic meters of gas per year by the mid-1980's.

Iran's proved natural gas reserves were estimated at over 16 trillion cubic meters. The offshore Pars field (formerly known as the C Structure) in the Persian Gulf was estimated to have gas reserves of 5.7 trillion cubic meters. Proved reserves of associated gas in the Khūzestān fields were estimated at 8 trillion cubic meters. The Khangiran field was estimated to contain over 500 million cubic meters of proved gas reserves. Natural gas reserves found in the Aghar, Gavarzin, Kangan, Nar, Salakh, Sarkhun, Suru, and other smaller fields constitute the remainder.

Plans were proceeding for development of the Pars gasfield, including a floating LNG plant that would be used to liquefy gas for export to the United States. Kvaerner Engineering A.S./Moss Rosenberg Verft A.S. (Norway) was to supply the plant, which would produce some 8.5 million cubic meters per day of LNG to be sold to Columbia Gas System Inc. of the United States under a 20-year contract. The LNG plant, terminal, and an onshore gas treatment plant were to cost about $830 million. Deliveries were scheduled to start in early 1980.

The longest running project planned to use Pars field gas was the Kalingas plant, which would export LNG to Japan. The initial participants were National Iranian Gas Co. (NIGC) (50%), Japan Kalingas (a group of 18 Japanese companies) (15%), International Systems & Controls Corp. (United States) (15%), Halfdan Ditlev-Simonsen & Co. (Norway) (7.5%), Chicago Bridge & Iron Co. (United States) (7.5%), and Enserch Corp. (United States) (5%). Following a complex series of transfers in ownership, all of NIGC's partners except Japan Kalingas and Chicago Bridge & Iron dropped the project. This left NIGC with 82.5%, Japan Kalingas with 15%, and Chicago Bridge & Iron with 2.5%. At the same time, the project was cut to around 10 million cubic meters per day. By late 1977, it appeared that Japan Kalingas would withdraw from the project and instead go ahead with another 50-50 LNG joint venture with NIGC. The remaining partners of Japan Kalingas were to implement a floating LNG plant system.

The new Japan Kalingas project included construction of an onshore liquefaction

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plant that would produce 2.5 million tons of LNG per year for export to Japan over 20 years, beginning in 1982. The total investment required was estimated at $1.9 billion, divided between LNG facilities ($767 million), five LNG carriers ($767 million), and terminal facilities in Japan ($384 million).

Soviet, Italian, and French groups were given contracts to build the IGAT-II gasline, which was to extend 1,420 kilometers from the onshore Kangan and Nar gasfields in southern Iran to Astara on the Soviet border. Work was to begin in 1978, with deliveries starting in 1981 and reaching target capacity by 1983. Planned on a larger scale than IGAT-I, which carries about 10 billion cubic meters of gas per year to the U.S.S.R., IGAT-II was to have a capacity of 28 billion cubic meters per year. Up to 31 million cubic meters was to be used in Iran's northern cities. The French group Spie-Batignolles/Capag-Cetra and the Italian firm Saipem S.p.A. were to construct sections of the line. The project was to cost about $2.4 billion. Payment for the gas would be in Soviet ruble credits that would be used to pay for Soviet construction of the northern section of the pipeline. The U.S.S.R. was also expected to provide most of the compressor stations under a gas barter deal.

The Kangan and Nar gasfields were to be developed by a European consortium headed by Elf-Aquitaine. The European Group of Oil Companies (EGOCO) was dissolved, and a new company, Segiran, was formed in which Elf-Aquitaine had a majority interest as a joint venture with NIOC. These fields were originally discovered by EGOCO.

NIOC was optimistic about planned gas reinjection programs because of successful results at the Haft Kiel and Gachsaran fields. Since mid-1976, about 11 million cubic meters of gas from the Naft Safid oilfield had been injected at Haft Kiel, and wet gas from the Pazanan gas domes was injected into the Gachsaran oil reservoir. The Marun field was to be next in early 1979. Contracts for gas reinjection from the Pazanan field were awarded, and the first of two facilities was scheduled to supply gas for Gachsaran by mid-1978.

Industrial development in northern Iran was to be bolstered by the 800-kilometer, 30- and 36-inch gas transmission system under construction to serve steel mills and petrochemical plants. The pipeline will transport gas from the Khangiran gasfield in Khorāsān Province to the Neka powerplant, which was under construction on the southern shore of the Caspian Sea in Māzandarān Province. The project included a gas-gathering system, a gas-treating plant, the pipeline, five compressor stations, a supervisory control system, a telecommunications system, and cathodic protection.[14]

A gas-processing facility with a 2.8-million-cubic-meter-per-day capacity was to be built at Gorzin on Qeshm Island and connected by undersea pipeline to Bandar 'Abbas. Production would be piped overland to industries in Kermān Province.

The Marun field was being developed to produce associated gas using 27 turbine-driven, single and tandem, natural gas compressor sets for gas gathering and transmission to be installed by Ralph M. Parsons Co. of the United States. The specially designed Solar Centaur compressors were to be located at seven sites in the field. The 23 tandem sets were to take gas off separators and pump it to pipeline pressure to NGL plants. The 4 single-body units were to deliver lean gas from the plant to feed the liquefied petroleum gas (LPG)-petrochemical installation being built by a consortium of Iranian and Japanese companies.[15]

Petroleum.—*Exploration.*—NIOC held exploration service contracts with several companies, but there was a general decline in exploration activities during 1977.[16] Even so, OSCO continued an active exploration program, increasing the number of seismic crews to six and conducting an active exploration program with an average of 14 drilling rigs for the year.

Deminex A.G. of the Federal Republic of Germany continued prospecting with some hope of initiating commercial production from the reservoir it had discovered on the Abadan Plain. Abadan crude was low-gravity and was expected to face marketing difficulties. An evaluation program was in progress. NIOC's own exploration was also active, with most efforts concentrated on the Sarveston oilfield near Shiraz.

France's Cie. Française des Pétroles (CFP) was expected to relinquish its 8,000-square-kilometer area in the Lar region. CFP drilled two dry holes in the prospecting area, located inland in southern Iran. Continental Oil Co. (Conoco) also relinquished its 25% share in the Bandar 'Abbas offshore exploration tract that it shared with Phillips Petroleum Co. Iran (50%) and Cities Service Co. (25%). Eight wells had been drilled since 1969, but no commercial discovery was made.

Sofiran had essentially ceased its exploration program but was preparing to produce from two of several small offshore discoveries near Hormuz. Negotiations with NIOC on its basic operating agreement

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were still in progress. Hormoz Petroleum Co. (HOPECO), owned by NIOC 50%, Petróleo Brasileiro S/A (PETROBRAS) 25%, and Mobil Oil Corp. 25%, was also exploring in the Strait of Hormuz and had some success. Iran Pan American Oil Co. (IPAC), Lavan Petroleum Co. (LAPCO), Soc. Irano-Italienne des Pétroles (SIRIP), and Iranian Marine International Oil Co. (IMINOCO) had all ceased exploration efforts.

Production.—Petroleum production for Iranian year 1977 averaged 5.7 million barrels per day, down slightly from the 5.9 million barrels per day produced in Iranian year 1976. OSCO's production reached 6.1 million barrels per day in the final quarter of 1977, but demand for Iranian crude was soft in early 1977 and production was at a lower pace. Most crude was exported, but domestic consumption was estimated at 450,000 barrels per day. Iran's domestic consumption was estimated to reach some 1.2 million barrels of crude oil per day by 1988.[17] Production in 1988 was being forecast to peak at 6 million barrels per day, down from the previous estimate of 7.6 million barrels per day.

Proved crude oil reserves were estimated at 65 billion barrels,[18] with most of the latest increase resulting from the gas injection program. NIOC reserve estimates run as high as 90 billion barrels, with about 20 billion barrels added from the secondary recovery program.

Much of Iran's crude oil contains salt in excess of the 11-pound-per-1,000-barrel limit placed on oil to be exported. Iran was planning to install over 2.8 million barrels per day of crude oil desalting capacity by 1981. Desalting facilities were to be built in about a dozen fields, including plants for two different reservoirs in the Ahwaz field. The desalting capacity added was expected to represent a large share of the country's oil production in the future.[19]

IPAC was producing petroleum from four fields. The Ardeshir field, which began production in November 1976, had reached 200,000 barrels per day and was IPAC's largest producing field. The Feridoun field (160,000 barrels per day) accounted for 44.6% of IPAC's total production in Iranian year 1977. The Darius and Cyprus fields had production capacities of 70,000 and 35,000 barrels per day, respectively.

LAPCO produced about 66.5 million barrels from its Sassan field in Iranian year 1977. The Bahram field (formerly the W Structure) was thought to have a potential of 50,000 barrels per day and was still being developed. A 14-inch oil line was extended to a new 1-million-barrel storage tank at the Lavan Island terminal, but a final decision had not been reached between NIOC and its LAPCO partner on development terms. LAPCO's productive capacity was also being increased by a secondary (waterflood) recovery project at the Sassan field.

The Khūzestān fields, operated by OSCO as an NIOC contractor, accounted for 90.1% of total Iranian year 1977 production. Development drilling was continuing at high levels but was expected to decline because of other major investments required for gas injection and desalting programs. Total new and expanded capacity was 460 million barrels per day. Despite completion of new facilities (including new production units, desalting plants, main oil lines, additional pumping capacity, etc.), there was a drop in productive capacity of the Khūzestān fields during 1977, caused mostly by a drop in reservoir pressures and the need to shut in numerous wells because of salt contamination. Capacity was expected to recover, however, to a level of 6.2 million barrels per day in Iranian year 1978 as desalting and gas-lift systems are commissioned.

The IMINOCO joint venture (NIOC 50% and Agip S.p.A., Phillips, and the Oil and Natural Gas Commission of India each 16.67%) produced oil from the Rostam and Rakhsh fields near Lavan Island. Total production from these two fields was 16.7 million barrels in Iranian year 1977.

SIRIP was the oldest of the Iranian oil-producing joint ventures with NIOC and produced from three fields northwest of Kharg Island. Total production capacity was about 55,000 barrels per day.

Sofiran (owned by Entreprise de Recherches et d'Activités Pétrolières (ERAP) 40%, Mitsubishi Oil Development Co., Ltd., 40%, and Soc. Nationale des Pétroles d'Aquitaine (SNPA) 20%), on the basis of a 1966 service contract agreement with NIOC, was preparing to begin production from the offshore Sirri C and Sirri D Fields. Facilities were installed to inject water during the initial phase of production. Commercial production was to begin during 1978 at about 50,000 barrels per day, later increasing to 100,000 barrels per day.

Refining.—Refineries at Abadan, Tehran (I and II), Shiraz, and Kermānshāh processed a total of 280.1 million barrels of crude oil in Iranian year 1977. The new crude distillation unit was completed at the Abadan refinery, bringing its throughput capacity to 600,000 barrels per day. Refineries were under construction at Isfahan (73 million barrels per year) and Tabrīz (29

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million barrels per year), and a refinery for Ahwaz (80 million barrels per year) was in the planning stage. The Masjed-e-Soleman topping plant processed only about 6.7 million barrels of crude oil in Iranian year 1977, and the Lavan topping plant processed 4.3 million barrels.

Iran's domestic distribution system was continuing to expand with several new petroleum products pipelines added, including those extending from Isfahan to Tehran, Ahwaz to Abadan, Tehran to Shāhrūd, Shāhrūd to Meshed and Gombad, Tabrīz to Reza'iyeh, Tehran to Rasht, Tehran to Sārī, and Marun to Isfahan. A new 550,000-barrel-per-day pipeline to carry crude from the Marun fields to a new refinery at Isfahan was nearing completion. The project was a joint effort of SNAM Progetti S.p.A. and Saipem of Italy. Moody International was to supervise construction of 26 storage tanks adjacent to the refinery. The largest tank capacity was to be 258,000 barrels.[20]

Petrochemicals.—Since the establishment of the Shiraz fertilizer complex in 1961, five additional petrochemical facilities have been completed by National Petrochemical Co. of Iran (NPCI) and its joint ventures. Existing facilities include those of Iran Fertilizer Co., which produces urea, ammonium nitrate, soda ash, sodium bicarbonate, and fertilizers; Abadan Petrochemical Co. Ltd. (NPCI 74% and B.F. Goodrich Iran S.A. 26%), which manufactures plastics and detergent raw materials; Shahpur Chemical Co. Ltd., which manufactures phosphoric fertilizers with imported phosphate rock and domestic sour natural gas (25% H_2S); Kharg Chemical Co. Ltd. (NPCI 50% and Amoco Iran Oil Co. 50%), producing propane, butane, and gasoline; Iran Carbon Co. (Cabot Corp. 50%, NPCI 20%, Industrial Mining and Development Bank of Iran 10%, International Finance Corp. 10%, and private interests 10%), which produces carbon black; and Iran Nippon Petrochemical Co. (INPC) (NPCI 50%, Mitsubishi Chemical Industries Ltd. 24%, and Nissho-Iwai Co., Ltd., 26%), which produces phthalic anhydride and DOP plasticizer. Phase 1 of the INPC plant was operational, and phase 2 was in an advanced stage of planning.

In 1977, the petrochemical industry had a capacity of nearly 3 million tons per year of petrochemical products. Several new plants were being constructed or planned. Iran Japan Petrochemical Co. Ltd. (IGPC) (NPCI 50% and Iran Chemical Development Co. 50%) was constructing a complex at Bandar-e Shahpur that included a salt-electrolysis plant for caustic soda and chlorine gas, an olefin-cracking plant, and a benzene and xylene plant. The complex was expected to cost $1.8 billion.

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[1]Physical scientist, Branch of Foreign Data.
[2]All data are for the Iranian calendar year, which is the year beginning March 21 of that stated.
[3]Where necessary, values have been converted from Iranian rials (Rls) to U.S. dollars at the rate of Rls70.4 = US$1.00.
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[17]Middle East Economic Survey (Cyprus). Iran. V. 21, No. 16, Feb. 7, 1978, p. 7.
[18]Middle East Economic Survey (Cyprus). What Iran Wants from the Consortium. V. 21, No. 17, Feb. 14, 1978, p. 3.
[19]Oil and Gas Journal. Iran Has Big Desalting and Pressure-Maintenance Job Ahead. V. 76, No. 11, Mar. 13, 1978, pp. 65-70.
[20]Oil and Gas Journal. New Crude Oil Pipeline Is Ready for Start-up in Iran. V. 76, No. 1, Jan. 2, 1978, pp. 73-77.

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The Mineral Industry of Iraq

By David E. Morse[1]

The petroleum industry continued to dominate the Iraqi mineral sector, and the country maintained its position as the third largest Middle East oil producer in 1977. Iraq had a signficant and growing cement industry and substantial production of sulfur, and also produced salt and construction materials for domestic consumption.

In June 1977 after a delay of almost 2 years, Iraq announced its 1976-80 5-year development plan. Allocations for projects under the plan totaled $45 billion,[2] of which $13 billion had been allocated through 1977. Under the plan, the growth rate of the gross domestic product (GDP) was to be 17% per year. The plan emphasized human development to meet Iraq's growing need for skilled manpower without importing large amounts of foreign labor. It provided for large-scale expansion of vocational, technical, and university-level training programs. It was to improve medical services, housing, and educational facilities for all levels of Iraqi society.

The plan sought to alleviate the economic constraints imposed by the nation's overburdened transportation, communications, and distribution systems and by its limited electrical generation capacity. Allocations under the plan for railroad and road construction were in excess of $3 billion. Nearly $2.2 billion was to be spent to increase electricity generation capacity from 950 megawatts to 4,000 megawatts by 1980. Iraq was also expanding its electricity distribution system by adding more 132-kilovolt supply lines and implementing a computer-managed 400-kilovolt national grid.

Iraq's major port of Basra on the Shatt al Arab was to be expanded and significant new port facilities were to be built on Khor al Zubair (the Zubair estuary). Khor al Zubair was dredged to accomodate ships of up to 60,000 deadweight tons and was to handle large bulk shipments for the new steel and fertilizer complexes and facilitate exports of sulfur and phosphatic fertilizers from northern Iraq.

In 1977, Iraq's economy continued to expand, with the GDP reaching $19 billion, an 18% increase over the 1976 level. The petroleum sector's contribution to the GDP decreased from 60% in 1974 to approximately 50% in 1977.

PRODUCTION AND TRADE

There was very little change in mineral production in Iraq in 1977, but progress was made on new facilities to expand mineral industry output by the end of the decade. Crude oil production declined to 857 million barrels, averaging 2.35 million barrels per day. Sulfur production increased to 640,000 tons, and cement showed a marked increase as new production units came onstream during the year.

Crude petroleum continued to be the nation's most important foreign exchange earner in 1977. Crude oil exports declined less than 1% in volume but increased 10.5% in value to $9.5 billion, representing 98% of the value of all exports. Sulfur exports were reported at 522,000 tons, with significant volumes destined for Egypt, the People's Republic of China, India, Tanzania, and Greece.[3]

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Table 1.—Iraq: Production of mineral commodities

Commodity[1]		1975	1976	1977[p]
Cement, hydraulic	thousand metric tons	2,385	2,728	3,170
Fertilizer, manufactured, nitrogenous, gross weight	metric tons	NA	140,154	160,239
Gas, natural:				
Gross	million cubic feet	368,648	468,553	e [2]370,802
Marketed[3]	do.	58,410	74,408	e [2]55,797
Gypsum	thousand metric tons	156	e160	e160
Natural gas liquids:				
Natural gasoline	thousand 42-gallon barrels	955	e960	e960
Propane and butane	do.	r1,687	r e1,700	e1,700
Petroleum:				
Crude	do.	825,521	881,621	857,093
Refinery products:				
Gasoline	do.	4,501	5,549	8,117
Jet fuel	do.	1,199	1,341	1,282
Kerosine	do.	4,200	3,490	3,418
Distillate fuel oil	do.	8,030	8,432	8,545
Residual fuel oil	do.	5,383	8,568	9,399
Lubricants	do.	360	372	390
Other	do.	9,441	7,360	8,972
Refinery fuel and losses	do.	2,057	2,130	2,602
Total	do.	35,171	37,242	42,725
Salt	thousand metric tons	r e64	r e64	82
Sulfur, elemental:				
Native, Frasch	do.	600	582	600
Byproduct[e]	do.	40	r40	40

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, lime and a variety of crude construction materials (clays, stone, and sand and gravel) are also produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2]Reported as estimate.

[3]Includes reinjected, if any.

Table 2.—Iraq: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Oxides, hydroxides, peroxides of metals	1,000	--	
NONMETALS			
Cement thousand tons	100	2,774	United Arab Emirates 1,774; Kuwait 1,000.
Chalk	27	59	All to Kuwait.
Clay products, nonrefractory	--	872	All to Saudi Arabia.
Fertilizer materials:			
Manufactured, nitrogenous	100	402	All to Bahrain.
Ammonia	--	15	All to Jordan.
Gypsum and plaster	7,243	12,022	Kuwait 7,832; United Arab Emirates 3,003; Qatar 699.
Lime	3,177	3,005	Kuwait 2,955; Jordan 50.
Stone, sand and gravel:			
Dimension stone, crude and partly worked	1,229	6,169	Kuwait 5,549; Qatar 320; Bahrain 300.
Gravel and crushed rock	100	--	
Sand, excluding metal bearing	--	2,120	Kuwait 1,900; Syria 220.
Sulfur: Sulfuric acid	--	2,612	All to Jordan.
Other: Building materials of asphalt, asbestos, and fiber cement	300	401	Do.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	62,298	16,117	Somalia 9,100; Kuwait 3,601; Sudan 3,416.
Gas, manufactured	31,200	--	
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	757	765	NA.
Refinery products:			
Gasoline do.	929	677	Netherlands 234; Switzerland 206; Bermuda 129.
Kerosine and jet fuel do.	1,134	1,278	Pakistan 819; Bangladesh 353; Switzerland 106.
Distillate fuel oil do.	1,438	3,202	India 1,063; Japan 925; Belgium-Luxembourg 243.
Residual fuel oil do.	1,261	2,688	Vietnam 1,400; Bermuda 321; Switzerland 314.
Lubricants do.	220	--	
Mineral jelly and wax do.	24	12	Syria 6; West Germany 4; Pakistan 1.

NA Not available.

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Table 3.—Iraq: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Oxide and hydroxide	1	2	All from India.
Metal including alloys:			
Scrap	12	--	
Unwrought	65	4,645	Mainly from Bahrain.
Semimanufactures	6,760	9,100	Hungary 2,443; Japan 867; Greece 833.
Arsenic:			
Natural sulfides	30	--	
Trioxide, pentoxide, acids	5	--	
Cobalt oxide and hydroxide	4	1	All from Japan.
Copper metal including alloys:			
Unwrought	23	2	All from United Kingdom.
Semimanufactures	5,809	2,612	United Kingdom 1,115; Japan 608; U.S.S.R. 161.
Iron and steel metal:			
Pig iron, including cast iron	7,509	416	United Kingdom 200; Egypt 157; West Germany 55.
Sponge iron, powder, shot	13,814	42,971	India 28,045; Spain 14,000; Japan 897.
Ferroalloys	--	1,655	Japan 980; France 675.
Steel, primary forms:			
Puddled bars, etc	6	--	
Blooms, billets, slabs, sheet bars	67	21	West Germany 14; Austria 6.
Coils for rerolling	10	1	Mainly from United Kingdom.
Tube and pipe blanks	368,367	200,920	Japan 133,096; West Germany 25,978; Italy 19,420.
Semimanufactures:			
Wire rod	3,778	3,807	Japan 2,647; U.S.S.R. 932; West Germany 175.
Other bars and rods	514,222	369,863	Japan 294,750; Czechoslovakia 29,970; U.S.S.R. 18,192.
Angles, shapes, sections	198,347	164,880	France 51,533; United Kingdom 40,482; Czechoslovakia 25,095.
Universals, plates, sheets	162,620	173,357	Japan 69,283; West Germany 32,947; Czechoslovakia 27,465.
Hoop and strip	1,101	858	West Germany 343; Japan 289; Belgium-Luxembourg 113.
Rails and accessories	503	3,175	United Kingdom 1,548; U.S.S.R. 1,116; India 233.
Wire	22,134	35,268	Japan 20,504; U.S.S.R. 4,538; West Germany 3,570.
Tubes, pipes, fittings	54,865	50,599	Japan 15,893; People's Republic of China 11,175; West Germany 11,015.
Lead:			
Oxide	22	20	All from West Germany.
Metal including alloys:			
Unwrought	19	2,547	United Kingdom 2,420; Austria 82; Denmark 45.
Semimanufactures	42	22	United Kingdom 14; Belgium-Luxembourg 6; Romania 2.
Magnesium metal including alloys:			
Unwrought	500	--	
Semimanufactures	--	1	All from United Kingdom.
Manganese oxide	671	--	
Mercury 76-pound flasks	558	150	All from Spain.
Nickel metal including alloys, all forms	119	6	Mainly from Greece.
Platinum metal, including alloys, all forms thousand troy ounces	482	968	Mainly from United Kingdom.
Tin metal including alloys:			
Unwrought	51	59	United Kingdom 33; Malaysia 23; Netherlands 2.
Semimanufactures	117	63	Belgium-Luxembourg 43; United Kingdom 18.
Titanium oxide	1,094	1,243	United Kingdom 580; Netherlands 228; West Germany 224.
Zinc:			
Oxide	257	34	Japan 21; France 11; United Kingdom 2.
Metal including alloys:			
Unwrought	68	329	Japan 309; North Korea 15; Poland 5.
Semimanufactures	360	443	Japan 270; Belgium-Luxembourg 147; United Kingdom 26.
Other:			
Ores and concentrates of molybdenum, tantalum, titanium, vanadium	24	--	
Oxides, hydroxides, peroxides of metals, n.e.s.	243	1,139	Belgium-Luxembourg 400; India 367; United Kingdom 206.
Metals including alloys:			
Metalloids	8	--	
Alkali, alkaline earth, rare-earth metals	34	--	
Pyrophoric alloys	6	(1)	NA.

See footnotes at end of table.

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Table 3.—Iraq: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	416	--	
Grinding and polishing wheels and stones	746	483	Syria 227; United Kingdom 98; Denmark 60.
Asbestos	1,482	1,306	Botswana 1,070; Canada 214; United Kingdom 13.
Barite and witherite	27,540	35,752	Kuwait 22,601; India 12,027; France 593.
Cement	34,120	72,621	India 30,636; U.S.S.R. 12,933; Turkey 10,751.
Chalk	97	--	
Clays and clay products (including all refractory brick):			
Crude	37,245	35,707	India 13,285; Turkey 10,838; France 4,310.
Products:			
Refractory (including nonclay brick)	10,661	12,709	Netherlands 2,924; West Germany 2,365; Austria 2,340.
Nonrefractory	24,808	9,734	Spain 4,728; Japan 1,350; Bulgaria 921.
Diamond, gem, not set or strung carats	50,000	60,000	India 40,000; Belgium-Luxembourg 20,000.
Fertilizer materials:			
Manufactured:			
Nitrogenous	11,178	10,535	Kuwait 5,000; Belgium-Luxembourg 4,500; Lebanon 980.
Phosphatic	37,914	23,450	Kuwait 10,000; West Germany 5,118; Belgium-Luxembourg 4,419.
Ammonia	(1)	5	Mainly from France.
Graphite, natural	--	10	Mainly from Japan.
Lime	40	2,047	India 1,545; Belgium-Luxembourg 402; West Germany 100.
Mica, worked, including agglomerated splittings	1	--	
Pigments, mineral:			
Natural, crude	3,840	1,869	Turkey 1,064; West Germany 500; Spain 250.
Iron oxides, processed	1,009	251	United Kingdom 131; Japan 62; West Germany 39.
Precious and semiprecious stones, except diamond, natural carats	10,000	--	
Pyrite, gross weight	--	1,100	All from India.
Salt and brine	90	50	All from United Kingdom.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	15,680	16,005	Italy 10,196; United States 1,103; West Germany 1,009.
Caustic potash and sodic and potassic peroxides	--	5	All from Japan.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	3,117	1,796	Jordan 1,285; Italy 511.
Other	6,000	3,393	Jordan 3,360; Belgium-Luxembourg 33.
Worked	(1)	38	United Kingdom 35; West Germany 3.
Gravel and crushed rock	1	20	All from West Germany.
Limestone (except dimension)	100	359	Belgium-Luxembourg 197; Pakistan 162.
Sand, excluding metal bearing	71	300	Australia 150; Turkey 100; Syria 40.
Sulfur:			
Elemental:			
Other than colloidal	41	20	United Kingdom 18; West Germany 2.
Colloidal	(1)	3	All from United States.
Sulfur dioxide	9	--	
Sulfuric acid	1,034	14	West Germany 7; United States 7.
Talc, steatite, soapstone, pyrophyllite	16	407	All from People's Republic of China.
Other:			
Oxides and hydroxides of magnesium, strontium, barium	204	3	West Germany 2; Denmark 1.
Bromine, iodine, fluorine	40	4	Mainly from West Germany.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	32,469	16,284	Greece 5,014; India 4,612; Lebanon 3,435.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	909	11	All from West Germany.
Carbon black	475	228	Italy 120; Sweden 60; India 30.

See footnotes at end of table.

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Table 3.—Iraq: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS — Continued			
Coal: Briquets of anthracite and bituminous coal	309	500	All from Turkey.
Coke and semicoke	513	1,043	West Germany 657; Japan 315; Belgium-Luxembourg 57.
Gas, hydrocarbon:			
Natural ---- kilograms	5	--	
Manufactured ---- do	9,299	1	Mainly from United States.
Hydrogen, helium, rare gases	12	23	United Kingdom 18; United States 3; Kuwait 1.
Petroleum refinery products:			
Gasoline ---- 42-gallon barrels	4,164	--	
Paraffin oil ---- do	--	14	All from Belgium-Luxembourg.
Diesel oil ---- do	22	--	
Lubricants ---- do	4,170	31,386	Italy 22,512; West Germany 3,422; Greece 3,310.
Mineral jelly and wax ---- do	667	630	Belgium-Luxembourg 155; Denmark 153; West Germany 144.
Other:			
Nonlubricating oils, n.e.s ---- do	11	93	United Kingdom 15; Romania 10; Turkey 7.
Pitch ---- do	28	307	All from U.S.S.R.
Petroleum coke ---- do	4	--	
Bitumen and other residues ---- do	6,999	--	
Bituminous mixtures, n.e.s ---- do	143,134	37,456	France 16,933; United States 11,895; United Kingdom 5,315.

NA Not available.
[1]Less than 1/2 unit.

COMMODITY REVIEW

METALS

Aluminum.—Completion of the 32,000-ton-per-year aluminum plant at An Nasiriya was rescheduled from 1977 to mid-1978, because shipments of equipment critical to the plant's operation had not yet been received. The plant was to have facilities for production of aluminum sheet, wire, foil, and household utensils. When completed, the plant was to provide employment for 800 persons.[4]

Iron and Steel.—Construction of the country's first steel mill by Creusot-Loire of France was in progress on the Khor al Zubair near Umm Qaşr in southern Iraq. Steel production at the 440,000-ton-per-year plant was to commence in early 1978 and would initially be based on domestic and imported scrap. The mill will have four 70-ton arc furnaces and ancillary facilities for preduction of rod, bar, sheet, and wire.

Creusot-Loire was also building two HyL direct-reduction modules at the mill site that were designed to produce 440,000 and 750,000 tons per year of sponge iron; the modules were scheduled to be completed by yearend 1978. In 1977, Iraq contracted Cia. Vale do Rio Doce of Brazil to supply 5.3 million tons of iron pellets over 5 years for the project. Auxiliary facilities to support the iron and steel mill included pumping stations and water pipelines to supply cooling and potable water from the Shatt al Arab, port facilities on the Khor al Zubair for materials receipt, and a 300 ton-per-day limestone quarry and crushing plant. Al-Bakr city was being built to provide housing and other amenities for the mill employees. The electricity generation capacity of the nearby Khor al Zubair powerplant was being doubled to 250 magawatts to ensure an adequate supply for the project.

NONMETALS

Cement.—In 1977, significant progress was made in achieving Iraq's goal of a 9-million-ton-per-year cement capacity by 1980. At Al-Kufa, about 170 kilometers south of Baghdad, the first kiln in a four-kiln kiln expansion program came on-line. Each kiln was to preduce 500,000 tons per year of ordinary portland cement. The $255 million expansion of the existing 225,000-ton-per-year plant was being done by F. L. Smidth & Co. A/S of Denmark and was

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slated for completion in 1978. Cement production was based on the use of limestone and marl from the Al Khuraib deposits and clay from the Al-Raghala deposit. A 22.5-kilometer-long, 1-meter-wide belt belt conveyor system consisting of nine 2.5-kilometer-long segments was employed to transport crushed limestone from Al-Khuraib to Al-Kufa. Wet clay was transported 13 kilometers over public roads in 20-ton vehicles from Al-Raghala to the cement plant. At Badoosh, 20 kilometers north of Mosul, a 1,500-ton-per-day dry-process kiln was added, bringing capacity to 750,000 tons per year; a second 1,500-ton-per-day dry-process unit was under construction. At Al-Falluja, 60 kilometers west of Baghdad, a 400,000-ton-per-year wet-process kiln was added to the two existing 120,000-ton-per-year kilns, and a 100,000-ton-per-year white cement plant was nearing completion. At Hammam al' Alil, 20 kilometers south of Mosul, plant capacity was increased to 740,000 tons per year by the addition of a 1,500-ton-per-day wet-process kiln. Despite the increases in capacity, cement remained in short supply throughout the year.

Fertilizer Materials.—Nitrogen.—Mitsubishi Heavy Industries, Ltd., of Japan was constructing a new ammonia-urea complex on the Khor al-Zubair in 1977. Natural gas from the south Rumaila oilfield was to be utilized as feedstock for the complex, which was to consist of four units with a total nitrogen content capacity of 540,000 tons per year in ammonia and 486,000 tons per year in urea. The four units were to be commissioned in 1979 and were to triple the nation's existing output.[5]

Phosphorus.—Design and engineering work for the integrated Akashat phosphate rock mine/Al Qa'im fertilizer complex continued under the supervision of Syndicate Belge d'Entreprises a L'Etranger (Sybetra) of Belgium. Davy Powergas Ltd. of the United Kingdom was contracted to build the Al Qa'im fertilizer complex, which was to have sections for annual production of 1.5 million tons of sulfuric acid, 400,000 tons of phosphoric acid (P_2O_5), 600,000 tons of monoammonium phosphate, and 250,000 tons of complex nitrogen-phosphorus-potassium (NPK) fertilizers. Alusuisse Engineering was to provide units to produce 11,000 tons per year of aluminum fluoride and 6,400 tons per year of cryolite. F. L. Smidth received a contract in 1976 to build a beneficiation plant at the mine. Planned output from the Akashat mine was 3.4 million tons per year of phosphate rock averaging 21% P_2O_5. The annual production of 1.7 million tons of beneficiated product was to be shipped by truck over a new 230-kilometer road that was being constructed from the mine to Al Qa'im. The cost of the project was $940 million. Production was to be initiated in 1979 and reach full capacity in 1980.

Sulfur.—Iraqi sulfur production has remained fairly constantly well below design capacity because of the restriction placed on output by the inability of the transport system to provide the means of shipping the product from the producing areas in the north to the export terminals near the Persian Gulf. Most Iraqi production came from Misraq State Sulfur Co.'s operation located south of Mosul. A Polish modification of the Frasch process was used to extract sulfur from a bedded, cavernous deposit estimated to contain 200 million tons of sulfur. Sulfur was also produced from natural gas at the Kirkuk processing plant.

MINERAL FUELS

Natural Gas.—In 1977, Iraq continued to flare more than 80% of its associated natural gas production. Studies on utilization of natural gas from both northern and southern oilfields were underway during the year. A 200,000-ton-per-year propane-bottling facility was completed at Az Zubayr, and construction of a 35-kilometer-long, 122-centimeter-diameter natural gas pipeline from the south Rumaila oilfield to the Khor al Zubair was well along. Natural gas was to be utilized by the newly developing steel and fertilizer industries that were being built on the Khor al Zubair near Umm Qaşr.

Petroleum.—Crude petroleum production averaged 2.35 million barrels per day in 1977. Iraq continued to expand production capacity by drilling wells to further exploit the south Rumaila, Jabal Fauqi, and Bai Hassan oilfields. The drilling program at the Luhais field was designed to bring it on-line at 50,000 barrels per day in 1978. Expansion of the Basra oil refinery was underway in 1977 as Technoexport of Czechoslovakia began construction of a 70,000-barrel-per-day expansion to double the refinery's capacity. SNAM Progetti S.p.A. of Italy's Ente Nazionale Idrocarburi (ENI) group was to build a plant for production of 100,000 tons per year of lubricating oils and 200,000 tons per year of asphalt at

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the Basra refining complex. Completion of the projects was to be realized in 1979.

The 1,005-kilometer Kirkuk-to-Dortyol (Turkey) crude oil pipeline was commissioned in 1977 at a rated capacity of 500,000 barrels per day. Turkey was to offtake 40% of its use; the remainder was destined for European markets. A petroleum products pipeline connecting the Basra and Durah refineries was also brought onstream during the year.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Iraqi dinars (ID) to U.S. dollars at the rate of ID1 = US$3.3862.

[3]Middle East Economic Survey. Iraq. V. XXXI, No. 14, Jan. 23, 1978, p. 7.

[4]U.S. Joint Publications Research Service. Translations on Near East and North Africa. No. 1738, Dec. 12, 1977, p. 43.

[5]British Sulphur Corp. Ltd. An Exporter Is Born, Nitrogen. No. 109, September-October 1977, p. 15.

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The Mineral Industry of Ireland

By William F. Keyes[1]

The Irish economy turned in a better performance in 1977 than any of its fellow members of the European Economic Community (EEC). There were sharp increases in investments, exports, and consumer demand, and the gross national product at constant prices rose 5%. Inflation, however, was still a problem, and the consumer price index was up 16.5% over that of 1976.

Except for lead and zinc, the mineral industry showed little change during the year, obtaining at best small increases in production. The major event was the coming onstream of the largest zinc mine in Western Europe. A new alumina plant was announced, plans were mooted to increase steel-melting capacity, and steady progress was made offshore in bringing Ireland's first natural gas field into production. On the other hand, a decision was announced just after yearend not to construct a zinc smelter to process domestic ores.

In 1977, about 50 companies held some 800 licenses to prospect over 40% of the surface of the country. These included such large U.S. and international companies as AMAX Inc., Rio Tinto-Zinc Corp. Ltd., New Jersey Zinc Co., Texasgulf Inc., Noranda Mines Ltd., ASARCO Incorporated, Johns Manville Corp., and Messina (Transvaal) Development Co. Ltd. Nevertheless, the last large ore body to be discovered in Ireland was the Navan zinc deposit in 1970, and some concern was expressed at the slow pace of discoveries to replace current mines when they are exhausted. Three mines (Silvermines, Tynagh, and Avoca) had very little reserves left.

The Irish Mineral Exploration Group (IMEG), representing 22 large companies such as Rio Tinto-Zinc, Tara Mines Ltd., and Noranda and holding over 80% of the exploration licenses, criticized the Irish Government's mining policies as discouraging prospecting. There was a change of government in 1977; in March, the former government had introduced new rules governing the terms of prospecting licenses, setting them at 2 years with extensions up to 6 years, and IMEG declared that 2 years was too short a term for the initial license. Nevertheless, the new Fianna Fail Government, although somewhat more oriented toward business, was not expected to alter the term.

PRODUCTION

Production of lead and zinc increased following startup of Tara's new Navan mine. Other mineral production was largely unchanged, and the outlook was uncertain in view of the unprofitability during 1977 of virtually all of the base metal mines.

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Table 1.—Ireland: Production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Copper, mine output, metal content, tons	9,856	4,064	4,877
Iron and steel: Crude steel	82	[e]80	--
Lead, mine output, metal content, tons	36,273	34,042	41,000
Mercury, 76-pound flasks	423	--	--
Silver, mine output, metal content, thousand troy ounces	1,384	925	936
Zinc, mine output, metal content, tons	66,653	62,792	116,300
NONMETALS			
Barite, do.	295,000	323,000	373,000
Cement, hydraulic	1,561	1,569	1,580
Gypsum	331	355	342
Lime	78	69	80
Pyrite	70	65	47
Sand and gravel[2]	5,036	5,770	5,464
Stone, limestone[2]	6,920	7,292	8,755
Other[3]	3,288	2,829	3,068
MINERAL FUELS AND RELATED MATERIALS			
Coal, bituminous, and anthracite	48	49	54
Coke, gashouse, including breeze	[r]36	33	[e]33
Peat:			
Agricultural use	67	71	83
Fuel use:			
Briquets	359	308	351
Sod peat[4]	2,099	1,834	2,015
Milled peat[5]	4,776	3,813	3,085
Petroleum refinery products:			
Gasoline, thousand 42-gallon barrels	4,277	3,528	4,219
Jet fuel, do.	823	160	606
Distillate fuel oil, do.	4,476	3,812	4,585
Residual fuel oil, do.	7,678	5,714	6,622
Other:			
Liquefied petroleum gas, do.	470	278	237
Naphtha, do.	312	162	188
Refinery fuel and losses, do.	836	616	--
Total, do.	18,872	14,270	16,457

[e]Estimate. [p]Preliminary. [r]Revised.

[1]In addition to the commodities listed, substantial quantities of stone and sand and gravel are produced by local authorities for such purposes as road maintenance, but data are not reported and available general information is inadequate to make reliable estimates of output levels.

[2]Excludes output by local authorities.

[3]Figures given as reported in source; includes output of granite, marble, silica rock, sand, calcspar, fire clay, and slate and clays for cement production, except that by local authorities.

[4]Includes output by farmers and by Bord Na Mona.

[5]Includes milled peat used in the production of peat briquets, listed elsewhere in this table.

TRADE

Ireland imports semimanufactured mineral products and exports concentrates of a number of base metals and nonmetallic minerals. Mineral trade with the United States consists principally of exports of barite, precipitated magnesia for refractories, and manufactured diamond, and imports of some lubricants, phosphate rock and potassic fertilizers, and iron and steel semimanufactures; trade with the United States is detailed in table 4.

Table 2.—Ireland: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal, unwrought and semimanufactures	[r]3,525	2,805	NA.
Copper:			
Ore and concentrate	41,268	18,529	Sweden 10,626; Spain 7,903.
Metal:			
Unwrought	423	961	NA.
Semimanufactures	1,076	1,567	NA.

See footnotes at end of table.

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Table 2.—Ireland: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Iron and steel:			
Roasted iron pyrite	27,645	27,776	NA.
Metal:			
Scrap	r7,528	8,219	NA.
Pig iron, ferroalloys, similar materials	179	--	
Steel, primary forms	3,258	2,008	NA.
Semimanufactures	r28,944	31,884	NA.
Lead:			
Ore and concentrate	58,641	56,836	Belgium-Luxembourg 19,809; France 13,200; West Germany 11,520.
Metal including alloys, unwrought and semimanufactures	2,868	2,903	NA.
Nickel metal, unwrought and semimanufactures	128	154	NA.
Platinum-group metals and silver:			
Ores and concentrates	7	10	NA.
Metals including alloys, all forms:			
Platinum value, thousands	r$602	$728	NA.
Silver do	r$69	$23	NA.
Tin metal, unwrought	--	5	NA.
Zinc:			
Ore and concentrate	146,535	128,208	Italy 39,807; Netherlands 32,146; Belgium-Luxembourg 31,953.
Metal including alloys, unwrought and semimanufactures	546	723	NA.
Other metals including alloys, all forms	r6,649	8,446	NA.
NONMETALS			
Abrasives, natural, n.e.s	r78	86	NA.
Asbestos	255	147	NA.
Cement	r117,087	113,590	NA.
Clays and clay products:			
Crude	43,246	33,785	NA.
Products:			
Refractory (including nonclay brick)	59,656	34,473	United Kingdom 8,803; West Germany 7,852; Poland 5,490; Italy 4,375.
Nonrefractory	r6,607	3,174	NA.
Fertilizer materials:			
Crude:			
Phosphatic	1,300	--	
Other	950	315	NA.
Manufactured:			
Nitrogenous	14,959	16,043	NA.
Phosphatic	30,514	62	NA.
Potassic	1,287	--	
Other	50,507	28,939	United Kingdom 27,590.
Gypsum and plasters	r67,601	66,504	NA.
Lime	--	87	NA.
Mica, all forms	5	1,477	NA.
Pigments, mineral, including processed iron oxides	86	1,587	NA.
Salt	194	223	NA.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	348	389	NA.
Worked	r240	342	NA.
Gravel and crushed stone	368,280	298,453	NA.
Sand, excluding metal bearing	3,192	8,032	NA.
Other:			
Crude	279,132	316,073	NA.
Slag, dross, and similar waste, not metal bearing	116	--	
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	11,138	19,530	NA.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	254	470	NA.
Coal, bituminous, and anthracite	56,229	30,625	NA.
Coke and semicoke	37,900	29,633	NA.
Peat, including peat briquets and litter	115,395	126,812	NA.
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	88	23	NA.
Kerosine do	1	2	NA.
Distillate fuel oil do	r292	1	NA.
Residual fuel oil do	r2,561	1,119	NA.
Lubricants do	r11	22	NA.
Other:			
Liquefied petroleum gas do	7	--	
Unspecified do	r35	1	NA.
Total do	r2,995	1,168	

rRevised. NA Not available.

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Table 3.—Ireland: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite and concentrate	--	(1)	NA.
Oxide and hydroxide	2,764	2,863	NA.
Metal including alloys:			
Scrap	323	187	NA.
Unwrought	5,336	7,705	United Kingdom 4,547; Canada 2,004.
Semimanufactures	r6,233	9,576	NA.
Chromium:			
Chromite	9,240	7,758	NA.
Oxide and hydroxide	40	66	NA.
Cobalt oxide and hydroxide	--	1	NA.
Copper metal including alloys:			
Scrap	30	66	NA.
Unwrought	190	300	NA.
Semimanufactures	r11,468	12,975	NA.
Iron and steel:			
Ore and concentrate	101	1	NA.
Metal:			
Scrap	3,825	1,261	NA.
Pig iron, including cast iron	1,164	708	NA.
Sponge iron, powder, shot	1,044	535	NA.
Ferromanganese	1,035	738	NA.
Steel, primary forms	r7,477	12,831	NA.
Semimanufactures:			
Bars, rods, angles, shapes, sections	r81,676	114,532	United Kingdom 35,262.
Universals, plates, sheets	r86,358	114,085	United Kingdom 38,058; France 12,431.
Hoop and strip	7,184	12,700	NA.
Rails and accessories	8,282	7,842	NA.
Wire	11,109	15,092	NA.
Tubes, pipes, fittings	r40,014	69,016	United Kingdom 32,480.
Castings and forgings, rough	r1,402	3,266	NA.
Total	r236,025	336,533	
Lead:			
Oxides	3,208	3,271	NA.
Metal including alloys, all forms	1,930	2,776	NA.
Magnesium metal including alloys, all forms	16	136	NA.
Manganese:			
Ore and concentrate	27,116	3,859	NA.
Oxides	744	297	NA.
Mercury 76-pound flasks	87	116	NA.
Molybdenum metal including alloys, all forms	1	1	NA.
Nickel:			
Matte, speiss, similar materials	--	4	NA.
Metal including alloys:			
Scrap	6	--	
Unwrought and semimanufactures	860	378	NA.
Platinum-group and silver metals including alloys:			
Platinum-group value, thousands	r$842	$623	NA.
Silver do.	r$698	$976	NA.
Rare-earth metals including alloys	37	15	NA.
Tin:			
Oxides	215	451	NA.
Metal, unwrought and semimanufactures	56	66	NA.
Titanium oxides	2,675	3,451	NA.
Tungsten metal including alloys, all forms	(1)	--	
Zinc:			
Oxides	527	931	NA.
Metal including alloys:			
Scrap	228	215	NA.
Unwrought	r2,419	2,820	NA.
Semimanufactures	r1,013	1,458	NA.
Other:			
Ores and concentrates	154	531	NA.
Ash and residue containing nonferrous metals	298	666	NA.
Oxides, hydroxides, and pentoxides of metals, n.e.s	183	281	NA.
Base metals including alloys, all forms	135	173	NA.
NONMETALS			
Abrasives, natural:			
Crude value, thousands	r$235	$377	NA.
Grinding and polishing wheels and stones	444	464	NA.
Asbestos	r6,848	5,275	NA.
Barite and witherite	122	244	NA.
Boron materials:			
Crude natural borates	1,048	1,436	NA.
Oxide and acid	146	81	NA.
Cement	47,492	47,752	NA.
Chalk	6,711	6,589	NA.

See footnotes at end of table.

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Table 3.—Ireland: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Clays and clay products (including all refractory brick):			
Crude	21,176	26,679	NA.
Products:			
Refractory (including nonclay brick)	20,700	14,429	NA.
Nonrefractory	r8,773	9,907	NA.
Feldspar and fluorspar	5,560	7,319	NA.
Fertilizer materials:			
Crude:			
Phosphatic	146,253	188,292	NA.
Potassic	r19	--	
Other	162	708	NA.
Manufactured:			
Nitrogenous	151,298	138,784	United Kingdom 51,527; Netherlands 29,629; Belgium-Luxembourg 19,529.
Phosphatic	116,394	142,906	NA.
Potassic	r169,894	256,290	East Germany 69,202; West Germany 63,629; France 48,180; Israel 29,553.
Other	r134,199	179,960	United Kingdom 126,553.
Ammonia	92,215	92,459	Netherlands 79,172.
Graphite, natural	81	151	NA.
Gypsum and plasters	3,236	6,919	NA.
Lime	6,189	4,757	NA.
Magnesite	33,490	10,166	NA.
Mica:			
Crude, including splittings and waste	189	240	NA.
Worked	2	2	NA.
Pigments, mineral:			
Natural, crude	188	148	NA.
Iron oxides, processed	1,015	1,205	NA.
Precious and semiprecious stones, excluding diamond value	r$420	$262	NA.
Salt	65,249	69,429	NA.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	13,877	13,186	NA.
Caustic potash and sodic and potassic peroxides	283	1,157	NA.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	1,272	1,565	NA.
Slate	340	287	NA.
Other	2,462	2,702	NA.
Worked:			
Slate	73	154	NA.
Paving stone and flagstone	20	3	NA.
Other	368	806	NA.
Dolomite	2,164	2,022	NA.
Gravel and crushed stone	176,901	163,905	NA.
Limestone, except dimension	2,016	2,016	NA.
Quartz and quartzite	645	443	NA.
Sand, excluding metal bearing	r99,996	88,252	NA.
Sulfur:			
Elemental:			
Colloidal	17,979	185	NA.
Other than colloidal	r27,888	12,189	NA.
Sulfur dioxide	105	143	NA.
Sulfuric acid	40,931	42,238	NA.
Talc, steatite, soapstone, pyrophyllite	2,021	2,444	NA.
Other:			
Crude	6,931	5,632	NA.
Slag, dross, and similar waste, not metal bearing	r1,151	712	NA.
Oxides and hydroxides of magnesium, strontium, barium	91	16	NA.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	7,865	10,058	NA.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	r1,848	5,891	NA.
Carbon black and gas carbon	r6,556	7,872	NA.
Coal, bituminous, and anthracite thousand tons	r1,380	1,213	Poland 461.
Coke and semicoke do	7	12	NA.
Hydrogen and rare gases	613	681	NA.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	16,842	11,641	Iran 5,482; Saudi Arabia 3,176; Kuwait 2,983.
Refinery products:			
Gasoline do	r4,792	4,843	NA.
Kerosine do	r2,418	3,209	NA.
Distillate fuel oil do	r3,843	4,526	NA.
Residual fuel oil do	r10,284	11,970	United Kingdom 9,014.

See footnotes at end of table.

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Table 3.—Ireland: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum —Continued			
Refinery products —Continued			
Lubricants ____ thousand 42-gallon barrels	r276	330	NA.
Other:			
Liquefied petroleum gas ____ do	r774	1,123	NA.
Mineral jelly and wax ____ do	r18	22	NA.
Nonlubricating oils, n.e.s ____ do	r11	626	NA.
Bitumen and other residues ____ do	r680	540	NA.
Bituminous mixtures, n.e.s ____ do	r39	50	NA.
Pitch and pitch coke ____ do	(1)	1	NA.
Total ____ do	r23,135	27,240	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	4,491	6,039	NA.

rRevised. NA Not available.
[1]Less than 1/2 unit.

Table 4.—Ireland: Mineral trade with the United States, 1976[1]

Commodity	Exports		Imports	
	Quantity (metric tons)	Value, thousands	Quantity (metric tons)	Value, thousands
METALS				
Aluminum metal including alloys	14	$35	34	$104
Copper metal including alloys	341	1,417	2	16
Iron and steel metal:				
Steel, primary forms	--	--	7	12
Semimanufactures:				
Bars and angles	29	29	110	82
Plates and sheets	--	--	60	48
Hoop and strip	--	--	4	8
Wire	64	76	130	278
Tubes and pipes	389	276	447	729
Castings and forgings	NA	1	54	88
Lead metal including alloys	--	--	2	8
Molybdenum ore and concentrate	--	--	(2)	1
Nickel metal including alloys	2	46	32	277
Platinum-group metals	--	--	6	905
Radioactive and associated materials	NA	3	--	--
Tin ore and concentrate	--	--	NA	1
Zinc metal including alloys	--	--	19	35
Other nonferrous metals:				
Ores and concentrates, n.e.s	90	75	1	1
Base metals including alloys, n.e.s	--	--	138	688
NONMETALS				
Abrasives, natural, including diamond	NA	6,472	359	172
Clays and refractory materials	38,702	7,368	--	--
Diamond and precious stones:				
Industrial diamond	NA	7,409	--	--
Gem diamond and precious stones	--	--	1	18
Fertilizer materials:				
Crude, phosphatic	--	--	22,786	656
Manufactured, potash	--	--	7,000	353
Salt, sodium chloride	19,037	58	--	--
Stone, sand and gravel:				
Dimension stone	2	3	--	--
Crushed and broken stone, sand and gravel	--	--	117	17
Other, crude	180,321	2,328	--	--
MINERAL FUELS AND RELATED MATERIALS				
Coal, all types	20	1	--	--
Petroleum refinery products:				
Lubricants	--	--	620	444
Petroleum jelly and mineral waxes	1	34	--	--
Total	XX	25,631	XX	4,941

NA Not available. XX Not applicable.
[1]Data may differ from those reported elsewhere in this chapter owing to a difference in source.
[2]Less than 1/2 unit.

Source: U.S. Department of Commerce, Bureau of the Census.

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COMMODITY REVIEW

METALS

Aluminum.—Late in the year, Alcan Aluminium Ltd. announced that it planned to proceed with construction of a $500 million alumina plant on Aughinish Island, County Limerick, in the Shannon estuary. Alcan had postponed the project early in 1976, when its partners in the project were A/S Ardal og Sunndal Verk of Norway and Gränges AB of Sweden. The renewed project was to be undertaken by Alcan (which took 40% ownership) in partnership with Billiton B.V. of the Netherlands (35%) and The Anaconda Company of New York (25%).

The plant, with a capacity of 800,000 tons per year of alumina, will have about 800 employees and will process imported bauxite. It was expected to be completed by 1982. Ireland was reportedly chosen as the site by Alcan because of its membership in the EEC, incentives offered by the Irish Government, and the availability of an excellent site well placed for shipping.

Copper.—Ireland's only copper mine, Avoca, was still unprofitable after 7 years of earnest effort by the present owner, Avoca Mines Ireland, a subsidiary of Avoca Mines Canada Ltd., in which the major shareholder (53.5%) is Discovery Mines Ltd. Messina (Transvaal) of the Republic of South Africa was interested in participating in the operation with further participation by the Irish Government, but it lost interest when copper prices declined to record low levels during the year.

A technical description of the mine was published.[2] Avoca is located in the Vale of Avoca, 40 miles south of Dublin, on the western bank of the Avoca River. The massive sulfide kuroko-type ore bodies, of Ordovician age, are associated with the Appalachian-Caledonian tectonic framework. The ore bodies are tabular, up to 60 feet wide and 1,500 feet long along the strike. Two underground lodes, the Pond and the South, are currently being worked, as is an open pit extension of the Pond ore. Mining underground is by blasthole stoping (45% of South lode mining) and by sublevel stoping (24% of Pond lode mining); the maximum mining depth is 900 feet but was formerly 1,200 feet. Access to the mine is by a decline to a depth of 1,400 feet, and the ore is brought to the surface on a conveyor belt. Mill-head grades average 0.64% copper and 7.16% sulfur. Two flotation concentrates are made: Copper (20% copper) and pyrite (48.5% sulfur). The copper concentrate is shipped through the port of Arklow to Spain and Sweden; the pyrite is bought by the Government fertilizer company Nitrigin Eireann Teoranta.

Iron and Steel.—Irish Steel Holdings Ltd. (ISH), the sole Irish steel producer, which is wholly owned by the Irish Government, announced plans to increase capacity at its scrap-processing plant on Haulbowline Island near Cork from 150,000 tons to 300,000 tons annually at a cost of about £40 million. It was hoped to get a loan of £20 million from the EEC.

The plan ran into opposition from the Commission of the EEC because of the surplus of steel capacity and plans for restructuring elsewhere in the EEC. There was also doubt that financing by the Irish Government would be permitted under EEC rules.

ISH suffered pretax losses of £1.25 million in the year ending June 30, 1977, and there was some question as to whether it could survive without modernization, which necessarily involved expansion of capacity. About 700 jobs were at stake.

Lead-Zinc.—Tara's Navan mine, a major addition to the world zinc industry, started up in June, almost 7 years after discovery of the deposit. Full rated output of 2.3 million tons per year of ore, equivalent to 400,000 tons of zinc concentrate (56% zinc) and 70,000 tons of lead concentrate (62% lead), will be attained late in 1978. Ore reserves, now estimated at 67 million tons of all classifications, were reported to contain 2.4% lead and 11.0% zinc. Several technical descriptions of the Navan mine were published.[3] The sphalerite-galena Navan ore body is a series of five superimposed tabular lenses in Lower Carboniferous limestone, aligned on a northwest-southeast axis and dipping 15° to 45° southwest, flattening out to 20° at depth. In the northeast, the lenses merge into a continuous vertical thickness of 60 meters. A major fault cuts the ore body along an east-northeast line, and the lenses on the southern side are downthrown about 75 meters. Depth to the ore body is 40 meters in the east and 200 meters at the shafts, some 350 meters down dip.

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Access to Tara's ore body is through a three-compartment development shaft and a decline for mobile diesel equipment; there is also a 5-meter-diameter circular production shaft. Stoping is by an underground benching cut-and-fill method. Cemented mill tailings are used as mine fill. The concentration plant uses conventional flotation methods, which are effective, giving recoveries of 89% of the zinc and 71% of the lead. The concentrates were shipped in 1977 to nine European smelters through the port of Dublin.

The Bula lead-zinc property, adjacent to the Navan mine but north of the Blackwater River, a tributary of the Boyne River, was evaluated by an arbitration board at about £40 million. The Irish Government, in taking a 24% share, would therefore be obligated to pay about £9.75 million; the Government was also to receive another 25% without payment.

Work continued during the year on investigation of the other ore body in the Navan area, held by Sabina Industries of Canada, known as the Rennicks and Bennett property. Messina (Transvaal) was conducting the investigation jointly with Sabina.

The mine at Silvermines, controlled by Mogul of Ireland Ltd. (owned 75% by Kerr-Addison Mines Ltd. of Canada since 1976), was reported in the annual report of the holding company, Silvermines Ltd. of Dublin, to have reserves sufficient for about 5 years' operation at the present rate of extraction. During 1976, Mogul milled about 1 million tons with an average grade of 2.27% lead and 6.26% zinc, to produce 24,300 tons of lead concentrates and 94,440 tons of zinc concentrates. The only other lead-zinc mine presently operating in Ireland, the Tynagh mine of Northgate Exploration Ltd. of Canada, was reported to be operating at a loss because of low metal prices.

New Jersey Zinc, under contract with the Government, conducted a 6-month feasibility study for a proposed zinc smelter to initially produce 100,000 tons of zinc from Navan ore; this would be Ireland's first base metal smelter. Early in January 1978, the study was submitted to the Government; it concluded that low international prices, widespread capacity underutilization, and the unlikelihood of a rapid economic upswing made it advisable to postpone the projected completion date of the smelter from 1981-82 to 1984-85. At almost the same time, the Soviet Government approached the Irish Government with a proposal for cooperation in building the smelter. The Irish Government was studying this proposition.

Magnesium.—A second seawater magnesia plant was planned, this time at Drogheda, north of Dublin, where the old wet-process cement plant was to be converted to this use. Planned capacity of the plant was 100,000 tons per year of seawater magnesia. Approval from the Irish Government was awaited by Cement-Roadstone Holdings Ltd., which was prepared to spend up to £29 million on the project. The company was also seeking partners for the venture.

Current magnesia production in Ireland was by Quigley Magnesite, a subsidiary of Pfizer Inc. of the United States, from burned dolomite and seawater at Dungarvan on the southern coast.

NONMETALS

Cement.—Three cement plants were operated in Ireland during 1977 by Cement Ltd. of Dublin; total kiln capacity was 2,120,000 tons at yearend after one of these plants was closed. The largest plant, with 1.4 million tons of capacity, was the Platin plant near Drogheda, County Meath, which brought a new kiln into operation during the year; at about the same time, the old Drogheda plant nearby was shut down.

MINERAL FUELS

Energy.—Ireland produced peat, which was important in that it generated about one-fourth of domestic electricity, and a small amount of coal. There was no production of liquid or gaseous hydrocarbons, but an offshore gasfield was expected to come into production by 1979. The country's total primary energy balances for 1975 and 1976 are given in table 5.

Natural Gas.—Development work on the Kinsale Head gasfield of Marathon Petroleum Ireland Ltd. began in April with the placement of the first of two drilling-production platforms, each of which will contain one vertical and six deviated wells. The field, located 27 miles off the southeastern coast, is scheduled to come into production by April 1979 or earlier at a rate expected to reach 125 million cubic feet per day. The product will be sold to Bord Gais Eireann Teoranta (Irish Gas Board) and Nitrigin Eireann Teoranta.

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Table 5.—Ireland: Supply and apparent consumption of fuels and power for 1975 and 1976

(Million tons of standard coal equivalent[1])

	Total primary energy	Coal, coke, peat	Petroleum and refinery products	Hydro-electric power
1975:				
Production	2.5	r2.4	--	0.1
Imports	8.9	.7	8.2	--
Exports	.7	.1	r.6	--
Apparent consumption	10.7	3.0	[2]7.6	.1
1976:				
Production	2.1	2.0	--	.1
Imports	8.6	.7	7.9	--
Exports	.3	.1	.2	--
Apparent consumption	10.4	2.6	[2]7.7	.1

rRevised.
[1]1 ton standard coal equivalent (SCE)=7,000,000 kilocalories.
[2]Includes refinery fuel and losses.

Source: International Energy Agency, Organization for Economic Cooperation and Development (OECD). Energy Balances of OECD Countries, 1974/1976 (Paris). 1978.

Results of offshore drilling in 1977 were not very encouraging, and the Marathon gas strike continued to represent the only commercially exploitable hydrocarbon find. Wildcat holes were drilled by Ranger Oil (Canada) Ltd. and Cities Service Oil Co. off the southern coast. Shell-Agip and Deminex Ireland Ltd. (for Amoco and Mobil Oil Co. (Ireland) Ltd.) drilled in the Porcupine Bank off the western coast; both holes were plugged and abandoned. At yearend, Amoco continued drilling in the Kish Basin, 20 miles off the coast in Dublin Bay.

Uranium.—Aquitaine Mining Ireland, a subsidiary of the French Elf-Aquitaine group, engaged in an airborne spectrometer survey. The survey, conducted for Aquitaine by Hunting Geology and Geophysics Ltd., was completed in September, but results were not released.

[1]Supervisory physical scientist, Branch of Foreign Data.
[2]Engineering and Mining Journal. Avoca Struggles Against a Combination of Problems. V. 178, No. 10, October 1977, pp. 92-95.
[3]Hoppe, R. Tara—Portent of the Future for Irish Mines? Engineering and Mining Journal, v. 178, No. 9, September 1977, pp. 83-98.
Mining Magazine. Tara's Navan Zinc Lead Mine. V. 137, No. 4, October 1977, pp. 300-318.

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The Mineral Industry of Israel

By David E. Morse[1]

The mineral industry of Israel, although small, is technologically advanced. Based on the recovery of dissolved solids from the Dead Sea and mining of phosphate rock, limestone, marble, various clay minerals, sand and gravel, and other dimension and crushed stone, the mineral industry furnished the foundation for Israel's cement, ceramic, construction, and nonmetallic chemical industries. Israel also had a flourishing refining and petrochemical industry based on imported crude oil. During 1977, mineral production increased because of the expanding world demand for fertilizer materials and the chemical products produced from Israel's minerals. Oil exploration remained active, and new discoveries were made in the Sinai.

The nation's economy continued to be sluggish in 1977. The gross national product (GNP) at $12.7 billion[2] was up only 0.5% in constant Israeli pounds over that of 1976. Inflation remained a major problem as the consumer price index escalated 34.6% during the year. While the economy stagnated, employment rose 4.4% to 1.2 million, and the unemployment rate remained below 4%. Israel has historically had a labor-deficient economy, and employers offered various incentives and concessions to keep skilled workers on the job.

On October 28, 1977, the Government decided to float the Israeli pound on the world market. Since July 1976, the pound had been pegged to a basket of five currencies and prior to that time to the U.S. dollar only. The float was accompanied by abolishment of the system of export premiums according to the value added and cancellation of the flat but not all-inclusive 15% levy on imports. The new policies effectively increased the cost of imports of goods and services nearly 25%.

PRODUCTION

Israel's mineral production increased significantly in 1977 because of the increased world demand for potash and phosphate rock. Beneficiated phosphate rock production nearly doubled to over 1.2 million tons, and potash sales increased by approximately 600,000 tons over the poor sales recorded in 1976. Output of elemental bromine, magnesite (periclase), and petroleum refinery products increased over that of 1976. Output of clay minerals, lime, and cement declined from the levels reported for 1976.

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Table 1.—Israel: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Copper cement (70%-80% Cu):[e]			
Gross weight	10,000	--	--
Metal content	7,500	--	--
Iron and steel metal:[e]			
Pig iron	40,000	40,000	40,000
Crude steel	[r]57,000	[r]80,000	100,000
NONMETALS			
Bromine:			
Elemental	18,000	20,900	31,500
Compounds	12,000	10,300	20,350
Cement, hydraulic thousand tons	2,184	1,999	1,852
Clays:			
Flint clay	66,000	70,000	30,500
Metabentonite	3,000	15,000	8,000
Kaolin	12,000	10,000	5,500
Other	2,000	4,000	1,000
Fertilizer materials:			
Crude:			
Phosphatic:			
Unprocessed thousand tons	2,326	1,630	3,400
Beneficiated do	882	639	1,218
Potassic:			
Gross weight do	[r]1,140	1,115	1,159
K_2O equivalent do	[r]696	680	707
Manufactured:			
Nitrogenous	176,557	182,288	187,980
Phosphatic (superphosphate)	246,100	288,900	303,200
Potassic	8,742	9,509	9,876
Gypsum	200,000	200,000	200,000
Lime	240,000	200,000	102,000
Salt, marketed (mainly marine)	114,947	86,561	NA
Sand:			
Glass sand	74,000	84,000	83,500
Other (for building industry) thousand cubic meters	5,000	4,500	4,983
Sodium compounds, n.e.s.: Caustic soda	24,156	24,009	26,836
Stone:			
Dimension: Marble	16,000	16,000	22,000
Crushed thousand cubic meters	14,000	13,000	NA
Sulfur:			
Byproduct of petroleum	[r]10,000	10,000	10,000
Sulfuric acid thousand tons	194	208	198
MINERAL FUELS AND RELATED MATERIALS			
Gas, natural, marketed million cubic feet	2,105	2,055	2,010
Peat[e] thousand tons	20	20	20
Petroleum:			
Crude:			
From Israel proper thousand 42-gallon barrels	250	262	256
From occupied Sinai[2] do	27,095	6	--
Refinery products:			
Gasoline do	7,768	7,999	6,375
Kerosine do	1,994	1,893	5,619
Jet fuel do	4,334	4,521	--
Distillate fuel oil do	12,130	13,136	8,012
Residual fuel oil do	19,456	20,014	28,944
Lubricants do	201	262	--
Other do	3,984	3,371	2,838
Refinery fuel and losses do	2,077	2,133	2,158
Total do	51,944	53,329	53,946

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, Israel reportedly has the capacity to produce 71 metric tons of U_3O_8 per year, but official data are not reported and available information is inadequate to make reliable estimates of output levels.

[2]Israeli control relinquished in November 1975.

TRADE

Israel's balance of trade remained highly unfavorable in 1977. Although exports increased 28% to approximately $3 billion, imports also rose over 16% which worsened the trade deficit by more than $4 million. The balance-of-payments picture brightened, however, as the deficit dropped from $3.3 billion in 1976 to $2.6 billion in 1977. Mining and quarrying exports were up 26% to $86.4 million because of increased exports of potash and phosphate rock. Mineral exports accounted for 3.3% of industrial ex-

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ports which increased over 30% during 1977.

Polished diamond exports were up 41% over the 1976 value and exceeded $1 billion for the first time, although total carat sales increased only marginally over the 3.3 million carats sold in 1976. The cost of rough diamond imports increased more than 50% in 1977, which significantly decreased the diamond industry's profit margin.

Israel continued to rely heavily on imports for fuels and refined metals. The cost of imported fuels increased 10.6% and represented approximately 18% of the value of all imported materials.

Exports and imports of mineral commodities for 1975 and 1976 are shown in tables 2 and 3.

Table 2.—Israel: Exports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal including alloys, all forms[2]	2,244	7,506	Switzerland 1,741; West Germany 1,254; Netherlands 951.
Copper:			
Copper cement	9,595	4,180	United Kingdom 3,395; Hungary 769.
Matte[3]	173	239	United Kingdom 104; Argentina 94; Hong Kong 35.
Metal including alloys:			
Scrap	[4]208	1,759	Belgium-Luxembourg 466; Italy 353; West Germany 314; Netherlands 191.
Unwrought and semimanufactures[5]	853	2,120	United States 1,149; Iran 453.
Iron and steel metal including alloys, all forms[6]	5,651	8,612	Iran 2,888; Romania 2,071; United States 1,025; West Germany 930.
Lead metal including alloys, all forms	53	589	West Germany 208; Belgium-Luxembourg 123; Malta 74; Republic of South Africa 62.
Nickel metal including alloys, all forms	2	34	United Kingdom 16; United States 8; Netherlands 4.
Other:			
Ash and residue containing nonferrous metals	407	562	Italy 231; West Germany 164; Netherlands 75.
Metals including alloys, all forms, value, thousands	$740	$375	Switzerland $86; Spain $82; Italy $42; Belgium-Luxembourg $41; Republic of South Africa $38.
NONMETALS			
Abrasives, natural, n.e.s.; Grinding and polishing wheels and stones, value	$198,000	$297,000	United States $136,000; Canada $82,000; West Germany $38,000.
Barite and witherite	411	163	Republic of South Africa 145; Finland 18.
Bromine[7]	1,367	2,010	United States 485; Argentina 361; Netherlands 221.
Clays and clay products (including all refractory brick):			
Crude[8]	1,081	779	Netherlands 705; Philippines 74.
Products:			
Refractory (including nonclay brick)	2,249	962	Greece 323; West Germany 244; Ethiopia 178; Iran 151.
Nonrefractory, value	$321,000	$272,000	Canada $198,000; Singapore $31,000; United States $26,000.
Diamond, gem, not set or strung[9], thousand carats	3,118	3,637	United States 1,213; Hong Kong 562; Netherlands 412; Belgium-Luxembourg 324.
Fertilizer materials:			
Crude, phosphatic	259,127	[10]341,445	Turkey 87,355; Italy 69,165; Belgium-Luxembourg 45,216; Romania 40,449.
Manufactured:			
Nitrogenous	36	6	Singapore 3; Cyprus 2; France 1.
Phosphatic[11]	160,213	140,066	Norway 55,064; Austria 24,061; France 21,432.
Potassic, value, thousands	$673	$1,279	Greece $1,046; Kenya $127.
Other, including mixed	712,765	623,966	Belgium-Luxembourg 113,955; Italy 101,596; United States 94,834.
Ammonia	4,645	3	All to Cyprus.
Lime	43	1,008	Ethiopia 776.
Magnesite	20,811	[12]21,266	Austria 10,985; West Germany 8,082; Australia 2,199.
Precious and semiprecious stones, except diamond, value, thousands	$4,860	$6,669	United States $2,700; Switzerland $1,017; West Germany $603.
Salt	4	63	All to West Germany.
Stone, dimension, all types	1,547	1,735	West Germany 1,259.

See footnotes at end of table.

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Table 2.—Israel: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Sulfur:			
Elemental, all forms	r21	27	All to Iran.
Sulfuric acid	329	1,064	Kenya 813; Ethiopia 148; Canada 103.
Other:			
Crude value, thousands	$344	$1,408	Iran $566; Nigeria $434; Cyprus $153.
Slag and ash	103	75	All to West Germany.
Bromine, chlorine, fluorine, iodine	6,906	8,750	Netherlands 2,483; United Kingdom 1,540; Italy 1,254; West Germany 1,242.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	2,440	880	Kenya 335; Thailand 237; Ethiopia 210.
Hydrogen, helium, rare gases	53	51	United States 41; Republic of South Africa 8.
Petroleum:[e 13]			
Crude and partly refined thousand 42-gallon barrels	26,065	--	
Refinery products:			
Gasoline do	1,323	1,796	NA.
Kerosine do	625	333	NA.
Jet fuel do	977	896	NA.
Distillate fuel oil do	2,127	5,482	NA.
Residual fuel oil do	935	--	
Lubricants do	144	--	
Other do	1,046	423	NA.
Total do	7,177	8,930	

[e]Estimate. [r]Revised. NA Not available.

[1]Data may be incomplete. The figures presented, unless otherwise specified, are the sum of listed detail for all countries for which a quantity figure is provided in official Israeli trade returns; additional quantities may have been exported to other countries for which only a value figure is provided. In some cases, where it is clear that a significant portion was exported for which no quantity figure was provided, the value figure has been provided in a footnote.

[2]Totals exclude quantities valued at $1,452,000 in 1975 and $1,137,000 in 1976.

[3]Totals exclude quantities values at $140,000 in 1975 and $93,000 in 1976.

[4]Total excludes quantity valued at $461,000.

[5]Totals exclude quantities valued at $130,000 in 1975 and $45,000 in 1976.

[6]Totals exclude quantities valued at $13,639,000 in 1975 and $3,623,000 in 1976.

[7]Elemental bromine is included in "Bromine, chlorine, fluorine, iodine" under "Other" nonmetals.

[8]Totals exclude quantities valued at $790,000 in 1975 and $344,000 in 1976.

[9]Totals exclude quantities valued at $322,000 in 1975 and $304,000 in 1976.

[10]Total excludes quantity valued at $477,000.

[11]Totals exclude quantities valued at $837,000 in 1975 and $2,532,000 in 1976.

[12]Total excludes quantity valued at $287,000.

[13]Bureau of Mines. International Petroleum Annual, 1975 and 1976.

Table 3.—Israel: Imports of mineral commodities

Commodity	Quantity: Metric tons unless otherwise specified		Value, thousands: Of reported quantity		Value, thousands: Of additional unreported quantity	
	1975	1976	1975	1976	1975	1976
METALS						
Aluminum:						
Bauxite and concentrate	NA	193	NA	$43	$48	$185
Oxide and hydroxide	307	258	$487	280	72	243
Metal including alloys, all forms	1,687	NA	26,881	NA	9,317	--
Chromium oxide, hydroxide, trioxide	NA	6	NA	52	149	50
Copper metal including alloys, all forms	404	408	25,766	16,477	11,888	6,195
Gold metal, unworked or partly worked troy ounces	NA	NA	NA	NA	29,541	19,500
Iron and steel metal:						
Scrap	2,637	352	2,256	20	--	--
Pig iron, ferroalloys, similar materials	2,288	1,543	1,815	944	385	718
Steel, primary forms	17,125	24,567	10,777	9,246	3,877	1,221

See footnotes at end of table.

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Table 3.—Israel: Imports of mineral commodities —Continued

Commodity	Quantity: Metric tons unless otherwise specified 1975	Quantity: Metric tons unless otherwise specified 1976	Value, thousands: Of reported quantity 1975	Value, thousands: Of reported quantity 1976	Value, thousands: Of additional unreported quantity 1975	Value, thousands: Of additional unreported quantity 1976
METALS —Continued						
Iron and steel metal —Continued						
Semimanufactures:						
Bars, rods, angles, shapes, sections	78,043	107,882	$78,020	$48,992	$12,667	$4,217
Universals, plates, sheets	25,732	23,140	41,581	25,102	60,496	59,410
Hoop and strip	684	564	2,865	1,707	2,524	2,695
Rails and accessories	35	6	64	3	1,344	606
Wire	110	29	230	132	12,049	6,503
Tubes, pipes, fittings	1,581	1,217	12,961	7,399	12,643	15,229
High-carbon and alloy steel shapes, not further described	410	87	2,481	1,124	1,656	1,404
Lead:						
Oxide	230	263	885	863	60	39
Metal including alloys, all forms	122	11	281	40	1,811	1,279
Magnesium metal including alloys, all forms	NA	NA	NA	NA	r377	1,164
Manganese oxide	105	NA	295	NA	28	73
Mercury 76-pound flasks	29	29	14	21	107	--
Nickel metal including alloys, all forms	121	35	1,377	1,009	1,528	1,184
Platinum-group metals including alloys, all forms troy ounces	NA	NA	NA	NA	475	398
Silver metal including alloys, all forms do.	NA	NA	NA	NA	6,023	3,388
Tin:						
Oxide	NA	NA	NA	NA	31	15
Metal including alloys, all forms	7	1	518	310	395	345
Titanium oxide	83	213	759	1,949	1,412	421
Zinc:						
Oxide	28	46	275	552	479	115
Metal including alloys, all forms	941	1,200	2,872	3,232	2,061	1,196
Other:						
Ores and concentrates	230	45	97	120	116	273
Oxides, hydroxides, peroxides of metals	3	NA	108	NA	692	761
NONMETALS						
Abrasives:						
Natural:						
Pumice, emery, natural corundum, etc	36	14	61	84	51	16
Grinding and polishing wheels and stones	NA	NA	NA	NA	968	919
Corundum, artificial	3	35	98	38	--	219
Asbestos	856	3,542	3,366	4,576	2,021	1,650
Barite and witherite	NA	NA	NA	NA	382	491
Boron materials, oxide and acid	NA	15	NA	112	141	30
Cement	35,878	37,155	3,683	3,717	27,798	7,603
Chalk	15	20	32	135	21	31
Clays and clay products (including all refractory brick):						
Crude clays, andalusite, kyanite, etc	NA	NA	NA	NA	2,566	2,530
Products:						
Refractory (including nonclay brick)	1,214	426	1,988	940	885	461
Nonrefractory	NA	NA	NA	NA	2,823	4,867
Diamond:						
Gem, not set or strung thousand carats	6,894	10,033	469,266	670,298	--	1
Worked:						
Industrial do.	1,742	2,250	7,211	10,455	--	2
Other do.	63	107	11,910	22,193	2,181	85
Diatomite and other infusorial earth	NA	86	NA	268	230	29
Feldspar and fluorspar	r459	610	98	160	237	157
Fertilizer materials, manufactured:						
Nitrogenous	252	713	655	662	3,342	677
Other, including mixed	NA	NA	NA	NA	23	36
Graphite, natural	4	8	14	28	34	42
Gypsum and plaster	29	23	25	47	52	32
Magnesite	475	624	126	261	40	44
Mica, crude, including splittings and waste	8	1	21	15	46	67
Pigments, mineral: Iron oxides, processed	NA	11	NA	232	365	57
Precious and semiprecious stones, except diamond:						
Natural	NA	NA	NA	NA	6,749	9,225
Manufactured, including synthetic	NA	NA	NA	NA	267	240
Salt	29	36	20	13	178	218
Sodium and potassium compounds, n.e.s	344	46	496	129	472	482

See footnotes at end of table.

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Table 3.—Israel: Imports of mineral commodities —Continued

Commodity	Quantity: Metric tons unless otherwise specified 1975	Quantity: Metric tons unless otherwise specified 1976	Value, thousands: Of reported quantity 1975	Value, thousands: Of reported quantity 1976	Value, thousands: Of additional unreported quantity 1975	Value, thousands: Of additional unreported quantity 1976
NONMETALS —Continued						
Stone, sand and gravel:						
Dimension stone:						
Crude and partly worked	19	136	$18	$733	$643	$79
Worked	NA	NA	NA	NA	473	1,052
Gravel and crushed rock	1,128	2,012	734	897	62	11
Quartz and quartzite	101	132	64	81	40	12
Sand, excluding metal bearing	NA	1	NA	26	43	--
Sulfur:						
Elemental, all forms	73	NA	294	NA	6,004	4,383
Sulfuric acid	NA	NA	NA	NA	2,963	766
Talc, steatite, soapstone, pyrophyllite	42	519	202	160	30	74
Other:						
Crude	3	4	86	23	201	53
Oxides and hydroxides of magnesium, strontium, barium	NA	8	NA	40	77	51
Bromine, iodine, fluorine	2	NA	16	NA	28	35
Building materials of asphalt, asbestos, and fiber cement, unfired nonmetals, n.e.s	NA	NA	NA	NA	228	111
Unspecified	23	NA	37	NA	109	169
MINERAL FUELS AND RELATED MATERIALS						
Carbon black	168	6	889	1,076	19	89
Coal, all grades	222	156	177	74	66	72
Coke and semicoke	NA	NA	NA	NA	684	521
Peat, including peat briquets and litter	NA	NA	NA	NA	85	120
Rare gases (argon)	14	20	46	75	43	--
Petroleum:[1]						
Crude and partly refined ---- thousand 42-gallon barrels	53,555	55,682	NA	NA	--	--
Refinery products:						
Gasoline, including natural:						
Aviation ---- do	125	70	NA	NA	--	--
Motor ---- do	368	--				
Kerosine ---- do	330	--				
Jet fuel ---- do	425	--				
Distillate fuel oil ---- do	1,265	--				
Residual fuel oil ---- do	2,550	3,429				
Lubricants ---- do	634	470				
Other ---- do	345	69				
Total ---- do	6,042	4,038	NA	NA	--	--
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	475	521	273	202	69	69

[r]Revised. NA Not available.
[1]Bureau of Mines. International Petroleum Annual, 1975 and 1976.

COMMODITY REVIEW

METALS

Copper.—The Timna mining complex, located in southern Israel 20 kilometers north of Eilat, remained in care-and-maintenance status throughout 1977. Timna's remaining reserves were 14 million tons of oxide zone copper ore containing 1.1% to 1.3% copper when the operation was shut down at the end of March 1976.

NONMETALS

Bromine.—Dead Sea Bromine Ltd. increased output of elemental bromine over 50% to 31,500 tons in 1977. The company used the waste brines from the adjacent potash plant of its parent company, Dead Sea Works Ltd. (DSW), as the raw material for bromine production. Elemental bromine was produced by heating the brines in a chlorine atmosphere. Renovation and expansion work was underway during 1977 to bring plant capacity to 60,000 tons of bromine per year. Construction of a 100-ton-per-day chlorine gas plant at Sedom was virtually completed by yearend, and chlo-

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rine production was to commence in early 1978. Chlorine gas had been obtained by transporting salt from DSW to Akko north of Haifa where chlorine was produced and then shipped back to Sedom. The chlorine plant was also to produce 112 tons per day of caustic soda, which was to be shipped to Arad for use at Dead Sea Periclase Ltd.'s (DSP) magnesium oxide plant.

Cement.—Nesher Israel Cement Enterprises Ltd., Israel's only producer, had an output of 1.85 million tons of ordinary portland cement during 1977. The company operated three plants. The 700,000-ton-per-year Haifa plant had four horizontal, rotary, wet-process kilns that were fired with fuel oil. The Bet Shemesh plant had a single dry-process, fuel oil-fired kiln with a capacity of over 600,000 tons per year. The Ramale plant had three rotary, wet-process, fuel oil-fired kilns with a capacity of 225,000 tons per year each. Israel's needs for white and other specialty cements were met by imports.

Fertilizer Materials.—*Phosphorus.*—For Negev Phosphates Ltd. (NPL), Israel's only producer of phosphate rock, 1977 was the company's biggest year in terms of crude and beneficiated rock output, although the sales value was below that of 1974. Phosphate rock production from the Oran and Little Crater mines returned to normal levels after the depressed years of 1975 and 1976. The Nahal Zin mine initiated production after March 31 and had an output of approximately 800,000 tons in 1977. The Nahal Zin operation was to produce 1 million tons of washed product grading 70% to 72% bone phosphate of lime (BPL) when full output is realized in 1980.

NPL produced 100,000 tons of phosphate rock from the Mishor Rotem mine for use in its phosphoric acid plant at Arad. The Arad plant utilized hydrochloric acid from the magnesium oxide plant of DSP to acidulate the 28% to 29% P_2O_5 material from the Mishor Rotem mine for phosphoric acid production. The plant produced 25,000 tons P_2O_5 in phosphoric acid in 1977.

During 1977, Israel Chemicals Ltd., NPL's parent organization, and West German partners established a joint venture company, Rotem Fertilizer Ltd. The company was to build a $30 million fertilizer complex based on the Mishor Rotem phosphate deposits. Initial plans called for construction of a 1,500-ton-per-day sulfuric acid plant and a 400-ton-per-day phosphoric acid plant to come onstream in 1981. Subsequently, phosphoric acid capacity would be doubled and facilities to produce super-triple-phosphate, ammonium phosphate, and complex fertilizers would be added.

Potassium.—DSW, located near Sedom at the southern terminus of the Dead Sea, operated at full capacity throughout 1977 although stocks on hand had risen to 700,000 tons of potash (KCl) at the end of March. Total sales during the year recovered from the low levels of 1976 and exceeded production, which allowed the company to reduce stocks considerably by yearend. DSW also produced industrial salts, table salt, and magnesium chloride salts that were used for medicinal purposes. The company's waste brines were utilized in the manufacture of elemental bromine and magnesium oxide. DSW planned to increase production capacity from 1.2 million tons to 1.5 million tons per year of potash by expanding the area of evaporation pans. Most of the output of DSW was destined for export.

Haifa Chemicals Ltd. produced high-purity potassium nitrate at its plants at Haifa. The company commissioned its second 110,000-ton-per-year plant in 1976, temporarily replacing the original plant of like capacity that had been damaged by a June 1976 fire. Repairs on the original plant were completed, bringing the company's capacity to 220,000 tons per year by yearend 1977.

Magnesium Compounds.—DSP, located near Arad in the north-central Negev Desert, distilled high-purity magnesium oxide from the waste brines of DSW's potash plant. The brines were pumped from Sedom on the southern shore of the Dead Sea to DSP's plant on the Rotem Plain. During 1977, production increased 11% to 27,800 tons. The company also produced approximately 60,000 tons of hydrochloric acid as a byproduct that was used by NPL in its nearby phosphoric acid plant. DSP planned to invest $8 million to expand capacity from 35,000 tons to 50,000 tons per year of magnesium oxide.

MINERAL FUELS

Energy.—The Ministry of Energy and Infrastructure was established in June 1977. The primary concerns of the new ministry were diversification of Israeli energy sources by utilizing coal and nuclear power, development of alternative energy sources, increasing oil exploration activities, expanding crude oil storage facilities, and increasing conservation. During 1977,

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Israel was conducting energy research projects to develop the oil shale resources near Arad, the Huleh Valley lignite deposits, and solar energy systems. Preliminary studies were conducted to determine the feasibility of constructing a tunnel and hydroelectric complex to exploit the existing hydroelectrical potential between the Mediterranean and Dead Seas. Israel planned to build a nuclear powerplant to begin operation in the mid-1980's.

Coal.—The Government appropriated $400,000 during 1977 in an effort to find coal in the Negev Desert. A coalbed with thickness varying from 3 to 6 feet at a depth of over 300 meters near Dimona had been discovered while prospecting for oil. Preliminary studies indicated that the coal had a calorific value of 4,500 kilocalories per kilogram. A feasibility study was in progress during the year to reactivate the abandoned Jebel Maghara coal mine in the northern Sinai. Coal from the Jebel Maghara mine would be used to supply part of the coal requirements of the Hadera powerplant that was to have four 300-megawatt units and begin operation in 1980.

Petroleum.—Indigenous crude oil production from the Helez oilfield averaged less than 83 tons per day during 1977, only a fraction of the domestic requirement of nearly 19,500 tons per day. In 1977, oil in commercial quantities was found offshore near At-Tur in the southwestern Sinai, and a significant quantity of natural gas was discovered in the northern Sinai near Rafah.

Israel's two oil refineries, a 6.5-million-ton-per-year plant at Haifa and a 3.5-million-ton-per-year unit at Ashdod, were operated by Oil Refineries Ltd. Total refinery production was nearly 54 million barrels of product during the year, an increase of 1% over that of 1976.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Israeli pounds (I£) to U.S. dollars at the rate of I£10.5=US$1.00.

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The Mineral Industry of Italy

By Roman V. Sondermayer[1]

A domestic and international economic slowdown adversely affected the mining industry of Italy during 1977. Based on published indicators, the mineral industry showed a decline of about 5%. The sharpest individual decline was about 25% in production of nonferrous metals, mostly because of the closure of all mercury mines.

The Government-owned concern, Ente di Gestione per le Aziende Minerarie e Metallurgiche (EGAM) was abolished by a law passed by the Italian Parliament in 1977. EGAM had operated a number of Government-owned mineral facilities but showed large financial losses. Ente Nazionale Idrocarburi (ENI) took over the mines and associated metallurgical installations, and Istituto per la Ricostruzione Industriale (IRI) took over EGAM's iron and steel facilities. ENI and IRI, both also State-owned concerns, were to reorganize certain operations and close others, but at yearend no further information was available.

During 1977, major events in the mineral industry were as follows: Discoveries of lead and zinc were made; development of the Campiano (Grosseto) pyrite mine continued; discovery of the first titanium deposit in Italy was made public; a new rutile deposit was discovered in Liguria; several discoveries of hydrocarbons, mostly gas, were made; and the Malossa ultradeep oil and gasfield near Bergamo came onstream.

PRODUCTION

During 1977, output of minerals showed mixed results, as shown in table 1. The mineral industry and its processing sector were owned by both Government and private industry. Some unprofitable Government-owned companies were kept in operation to maintain employment.

Table 1.—Italy: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
METALS				
Aluminum:				
Bauxite		32,165	24,200	34,525
Alumina[e]		742,000	[r]750,000	750,000
Metal:				
Primary		190,409	206,465	260,124
Secondary		151,000	198,000	225,000
Antimony:				
Mine output, metal content		1,010	1,015	829
Regulus		1,444	1,471	768
Cadmium, smelter output		409	436	449
Copper:				
Mine output, metal content		917	916	[e]630
Metal, secondary only[1]		19,000	22,000	28,000
Iron and steel:				
Iron ore and concentrate[2]	thousand tons	540	514	470

See footnotes at end of table.

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Table 1.—Italy: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
METALS —Continued				
Iron and steel —Continued				
Metal:				
Pig iron	thousand tons	11,350	11,631	11,411
Ferroalloys:				
Blast furnace	do	61	65	64
Electric furnace	do	179	192	191
Crude steel	do	21,836	23,947	23,334
Steel, semimanufactures:				
Hot-rolled:				
Wire rod	do	1,113	1,309	1,483
Sections	do	6,291	7,186	7,591
Plates and sheets	do	5,190	5,559	5,591
Hoop and strip	do	630	843	824
Railroad track material	do	199	235	199
Ingots, semimanufactures and solids for tubes	do	1,110	1,060	1,012
Other	do	879	781	708
Total hot-rolled	do	15,412	16,973	17,408
Casting and forgings	do	569	570	669
Cold-rolled sheet	do	2,418	2,893	2,829
Seamless tubes	do	851	806	772
Lead:				
Mine output, metal content		28,990	29,395	30,900
Metal:				
Primary		33,197	46,013	34,215
Secondary		56,800	72,187	NA
Magnesium metal, primary		6,344	7,033	7,286
Manganese:				
Mine output, gross weight		--	4,461	9,314
Mine output, metal content		--	1,338	2,798
Mercury metal	76-pound flasks	31,677	22,278	406
Silicon, elemental		14,100	17,700	e20,000
Silver metal	thousand troy ounces	1,157	1,593	1,222
Tin alloys		6,000	6,100	e6,100
Zinc:				
Mine output, metal content		r75,722	80,327	77,349
Metal, primary		179,732	189,424	176,593
NONMETALS				
Asbestos		146,980	164,788	149,327
Barite		212,868	179,107	136,369
Cement, hydraulic	thousand tons	34,235	36,327	38,204
Clays, crude:				
Bentonite	do	280	235	280
Refractory (excluding kaolinitic earth)	do	251	234	259
For cement		r4,369	NA	NA
For brick and terra cotta	thousand tons	r32,729	NA	NA
Fuller's earth	do	70	25	6
Kaolin	do	78	82	81
Kaolinitic earth	do	28	27	(3)
Diatomite		r29,970	NA	NA
Feldspar		185,209	182,605	213,593
Fertilizer materials:				
Crude, potassium salts, natural	thousand tons	1,834	1,696	1,879
Manufactured, gross weight:				
Nitrogenous	do	3,029	2,804	2,715
Phosphatic	do	783	817	1,098
Potassic	do	282	267	300
Mixed and unspecified	do	1,910	1,458	1,771
Ammonia		17,614	14,831	13,783
Fluorspar, all grades		231,253	210,812	185,749
Graphite, all grades		1,492	3,848	3,819
Gypsum (except for dimension stone use)	thousand tons	e4,200	4,200	4,180
Lime, hydrated and quicklime	do	2,185	2,188	2,197
Pumice and related materials:				
Pumice and pumiceous lapilli	do	900	900	900
Pozzolan		5,700	5,700	5,700
Pyrite, all kinds:				
Gross weight	thousand tons	962	850	863
Sulfur content	do	414	366	371
Salt:				
Marine, crude	do	1,220	603	e600
Other, including brine	do	3,191	3,410	3,600
Sand and gravel:				
Silica sand	do	r4,529	NA	NA
Volcanic sand	do	r110	NA	NA
Other sand and gravel	do	r125,838	NA	NA

See footnotes at end of table.

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Table 1.—Italy: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
NONMETALS —Continued				
Sodium and potassium compounds, caustic soda		10,018	11,391	11,150
Stone:				
Dimension:				
Calcareous:				
Alabaster and onyx	thousand tons	[r]26	NA	NA
Marble in blocks:				
White	do.	984	NA	NA
Colored	do.	1,023	NA	NA
Schist	do.	168	NA	NA
Travertine	do.	1,337	NA	NA
Tufa	do.	5,837	NA	NA
Other:				
Gneiss	do.	387	NA	NA
Granite	do.	493	NA	NA
Lava, basalt and trachyte	do.	5,042	NA	NA
Porphyry	do.	437	NA	NA
Sandstone	do.	1,475	NA	NA
Serpentine	do.	5,292	NA	NA
Slate	do.	100	NA	NA
Tuff, volcanic	do.	5,955	NA	NA
Crushed and broken:				
Dolomite	do.	1,427	NA	NA
Limestone	do.	55,763	NA	NA
Quartz and quartzite	do.	421	NA	NA
Strontium minerals[e]		720	700	700
Sulfur, native:				
Ore		500,296	349,982	638,068
Concentrate and filtrate (85% to 90% sulfur)		43,967	34,623	35,610
Fused and briquets		20,227	13,412	2,201
Talc and related materials		144,082	153,836	162,437
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bituminous rock, natural:				
For distillation		57,099	54,299	64,924
For paving		103,988	76,177	77,419
Carbon black		[r]135,845	144,045	158,630
Coal:				
Subbituminous (sulcis coal)	thousand tons	2	1	([3])
Lignite	do.	2,063	2,028	1,871
Coke, metallurgical	do.	8,114	7,970	7,676
Gas, natural, marketed	million cubic feet	514,252	552,336	485,115
Natural gas liquids, natural gasoline	thousand 42-gallon barrels	408	120	281
Petroleum:				
Crude	do.	6,934	7,553	6,139
Refinery products:				
Gasoline:				
Aviation	do.	571	376	416
Motor	do.	119,136	122,363	135,462
Jet fuel	do.	11,202	12,920	12,988
Kerosine	do.	23,161	26,760	23,104
Distillate fuel oil	do.	179,659	200,527	198,706
Residual fuel oil	do.	282,428	289,148	305,342
Lubricants	do.	3,694	4,795	5,586
Other:				
Refinery gas	do.	3,193	3,227	2,544
Liquefied petroleum gas	do.	25,071	27,061	27,006
Naphtha	do.	[r]47,973	55,364	43,362
Paraffin	do.	47	165	213
Bitumen	do.	10,696	10,288	10,317
Unspecified	do.	[r]1,685	1,616	1,321
Partly refined oil	do.	27,655	31,232	40,633
Refinery fuel and losses	do.	43,628	47,145	49,180
Total	do.	[r]779,799	832,987	856,180

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]Includes secondary blister chiefly for production of copper sulfate and other chemical uses.

[2]Excludes pelletized iron oxide derived from pyrite.

[3]Less than 1/2 unit.

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TRADE

Italy remained dependent on imports of many minerals and almost all mineral fuels. Details of foreign trade in 1975 and 1976 are shown in tables 2 and 3.

Table 2.—Italy: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Bauxite	5,912	1,390	NA.
Oxide and hydroxide	364,195	450,547	Netherlands 188,573; U.S.S.R. 145,789; United Kingdom 73,211.
Ash and residue containing aluminum	3,783	3,600	West Germany 2,040; France 1,371.
Metal including alloys:			
Scrap	223	767	West Germany 441; United States 165.
Unwrought	33,829	10,644	West Germany 4,550; France 1,612.
Semimanufactures	58,235	83,803	France 25,257; West Germany 23,842.
Antimony metal all forms including waste and scrap	1,108	494	Netherlands 100; West Germany 79; Belgium-Luxembourg 56.
Arsenic trioxide, pentoxide and acids	25	1	NA.
Beryllium oxide and hydroxide	3	NA	
Bismuth metal	11	18	United Kingdom 7.
Cadmium metal including alloys, all forms	102	425	West Germany 225; Belgium-Luxembourg 95.
Chromium:			
Chromite	3,811	2,961	Yugoslavia 1,160; France 1,127.
Oxide and hydroxide	1,020	1,729	France 1,341.
Metal including alloys, all forms	17	13	NA.
Cobalt:			
Oxide and hydroxide	NA	1	NA.
Metal including alloys, all forms	4	43	West Germany 20.
Columbium and tantalum metal, all forms (including waste and scrap)	32	5	NA.
Copper:			
Ore and concentrate	r2,901	2,807	Spain 1,652; Bulgaria 1,012.
Matte	741	NA	
Ash and residue containing copper	10,141	9,883	West Germany 8,491.
Copper sulfate	319	1,770	France 772.
Metal including alloys:			
Scrap	3,249	11,939	West Germany 10,356.
Unwrought	6,072	4,850	West Germany 2,115; Romania 1,184; Greece 500.
Semimanufactures	52,715	63,022	France 17,668; West Germany 14,706.
Gallium, indium, thallium kilograms	11,000	6,200	West Germany 5,500; Switzerland 400.
Germanium do	5,000	800	NA.
Iron and steel:			
Ore and concentrate	12,055	--	
Roasted pyrite thousand tons	224	142	Austria 74; France 39; Belgium-Luxembourg 17.
Metal:			
Scrap do	5	24	West Germany 17; Belgium-Luxembourg 3; France 2.
Pig iron including cast iron, spiegeleisen, powder and shot do	8	8	France 2; Netherlands 1.
Ferroalloys do	27	33	West Germany 9; Sweden 6; France 5; Belgium-Luxembourg 2.
Steel, primary forms do	964	810	Venezuela 148; France 143; United States 92; United Kingdom 76; Greece 65.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	1,958	2,120	West Germany 602; France 365; Libya 254; Algeria 105.
Universals, plates, sheets do	1,394	1,094	France 169; United States 163; West Germany 146; United Kingdom 119.
Hoop and strip do	88	70	France 14; Romania 9; Yugoslavia 8; People's Republic of China 8; West Germany 3.
Rails and accessories do	37	41	Cuba 19; Brazil 5; Egypt 5; Switzerland 5; Hungary 2.
Wire do	41	58	Algeria 13; France 12; West Germany 5; Poland 5; Libya 4.
Tubes, pipes, fittings do	1,780	1,833	U.S.S.R. 861; West Germany 146; Iran 135; France 132; United Kingdom 64.
Castings and forgings, rough do	48	36	Yugoslavia 11; West Germany 4; France 4; Liberia 2.
Total do	5,346	5,252	
Lead:			
Ore and concentrate	20,017	26,554	Greece 9,718; U.S.S.R. 8,480; Austria 5,225.

See footnotes at end of table.

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Table 2.—Italy: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
Lead —Continued			
Ash and residue containing lead	350	12,906	Belgium-Luxembourg 7,584; France 4,969.
Oxide	728	76	NA.
Metal including alloys:			
Scrap	191	--	
Unwrought	3,529	--	
Semimanufactures	1,241	973	Libya 410; Saudi Arabia 347.
Magnesium metal including alloys:			
Scrap	633	1,081	United States 620; France 216; West Germany 131.
Unwrought	4,221	5,288	West Germany 1,356.
Semimanufactures	172	172	France 106.
Manganese:			
Ore and concentrate	33	2,243	France 2,228.
Oxide and hydroxide	81	17	NA.
Metal all forms	24	2	NA.
Mercury 76-pound flasks	49,459	40,931	West Germany 13,663; Netherlands 5,744; United Kingdom 4,264.
Molybdenum metal including alloys, all forms kilograms	3,000	1,000	NA.
Nickel:			
Matte, speiss and similar materials	23	22	NA.
Metal including alloys:			
Unwrought	413	101	Netherlands 46; Yugoslavia 21.
Semimanufactures	1,109	2,294	Switzerland 1,731; West Germany 141; Morocco 137.
Platinum-group metals and silver including alloys:			
Platinum group thousand troy ounces	58	41	West Germany 11; United Kingdom 11.
Silver do	1,447	1,350	France 322; Spain 161.
Rare-earth metals:			
Oxides and other compounds value	$202	NA	
Metals, cerium	13	12	NA.
Selenium, elemental kilograms	700	151	Netherlands 82.
Silicon, elemental	7,134	252	Japan 175; West Germany 26.
Tellurium and arsenic	NA	13	United Kingdom 9; Netherlands 3.
Thorium:			
Ore and concentrate	NA	815	NA.
Thoria value	r$4	NA	
Tin:			
Oxide	186	176	France 139; West Germany 18.
Metal, all forms	558	155	France 113.
Titanium:			
Ore and concentrate	15	1	NA.
Oxides	18,498	32,670	West Germany 3,776; Poland 3,627; France 3,499.
Metal including alloys, all forms	48	59	U.S.S.R. 15; Algeria 7.
Tungsten metal including alloys, all forms	27	94	West Germany 33.
Vanadium oxide and hydroxide kilograms	NA	104	NA.
Zinc:			
Ore and concentrate	10,339	17,061	France 14,515.
Ash and residue containing zinc	6,602	8,365	West Germany 7,570.
Oxide	1,343	765	West Germany 339; France 265.
Metal including alloys:			
Scrap	703	2,098	France 1,495.
Blue powder	890	582	Belgium-Luxembourg 153.
Unwrought	30,013	40,819	United States 26,496; France 4,669.
Semimanufactures	624	673	Portugal 73.
Zirconium:			
Ore and concentrates	21	155	NA.
Metal including alloys, all forms	2	21	NA.
Other:			
Ore and concentrates	17	63	West Germany 38.
Ash and residue containing nonferrous metals, n.e.s	3,552	2,207	West Germany 1,734.
Oxides and hydroxides	373	1,275	West Germany 269; France 120.
Metal including alloys, all forms:			
Metalloids, n.e.s	1,300	NA	
Alkali, alkaline earth and rare-earth metals, n.e.s	41	42	NA.
Pyrophoric alloys	1	(1)	NA.
Base metals including alloys, all forms, n.e.s	7	6	NA.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, corundum, etc	129,811	251,861	United Kingdom 136,485; United States 54,163; Algeria 39,602.
Dust and powder of precious and semiprecious stone value	$39	NA	
Grinding and polishing wheels and stones	10,869	12,751	France 1,648; West Germany 1,323; Romania 1,309.

See footnotes at end of table.

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Table 2.—Italy: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Asbestos	81,073	82,833	West Germany 20,906; Japan 15,733; France 10,401.
Barite and witherite	16,079	24,344	Algeria 13,841; Libya 4,615; Egypt 3,473.
Boron materials:			
Crude natural borates	40	27	NA.
Oxide and acid	2,644	3,409	West Germany 1,340; France 877; Bulgaria 551.
Cement thousand tons	744	796	Libya 227; Israel 177; Algeria 102; Yugoslavia 91.
Chalk	779	750	NA.
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite	19,061	23,478	West Germany 8,151; France 3,371.
Kaolin	40,917	51,001	France 39,927; Spain 6,100.
Other	7,350	1,273	United States 20.
Products:			
Refractory (including nonclay bricks)	84,998	80,497	West Germany 13,142; France 9,700; Romania 8,257; Algeria 6,492.
Nonrefractory thousand tons	1,041	1,669	France 391; West Germany 389; Austria 131, Switzerland 94.
Cryolite and chiolite	(1)	26	NA.
Diamond:			
Gem, not set or strung value, thousands	$7	$277	United Kingdom $178; Saudi Arabia $77.
Industrial do	$27	NA	
Diatomite and other infusorial earths	1,441	1,173	NA.
Feldspar	22,539	24,519	West Germany 10,556.
Fertilizer materials:			
Crude	6,610	6,470	France 4,908; Libya 418.
Manufactured:			
Nitrogenous thousand tons	720	1,115	Turkey 246; Egypt 174; El Salvador 129; India 105; People's Republic of China 103.
Phosphatic do	24	6	Libya 5; France 1.
Potassic do	68	94	Algeria 21; Greece 17; United States 10.
Other do	154	148	Zambia 54; France 28; West Germany 10.
Ammonia	63,332	40,860	Greece 37,792; Cameroon 1,289; Ivory Coast 1,000.
Fluorspar	84,416	104,609	United States 64,160; West Germany 31,711.
Graphite, natural	1,792	1,314	France 872.
Gypsum and plasters	10,559	9,653	France 1,261.
Lime	94,401	118,154	Libya 82,995; Switzerland 25,419.
Lithium ore	5	7	NA.
Magnesite	212	4,108	United States 2,100; United Kingdom 1,080.
Mica:			
Crude, including splittings and waste	499	1,084	West Germany 759.
Worked, including agglomerated splittings	65	104	NA.
Pigments, mineral including processed iron oxides	1,935	36,009	Austria 8,320; Turkey 7,259; Yugoslavia 4,609; France 4,429.
Precious and semiprecious stone except diamond:			
Natural value, thousands	$25	NA	
Manufactured kilograms	155	2,148	NA.
Pyrite (gross weight)	40,314	13,612	Switzerland 8,217; Austria 3,152; West Germany 1,683.
Salt, all forms	59,453	91,933	Denmark 28,380; Greece 14,630.
Sodium and potassium compounds:			
Caustic soda	300,240	357,826	Yugoslavia 94,844.
Caustic potash	869	1,591	NA.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	257,261	260,789	Spain 51,248; West Germany 29,547; France 26,050.
Slate	2,622	2,603	NA.
Other	76,352	98,395	West Germany 44,661; Switzerland 17,431.
Worked, all forms	697,355	867,622	West Germany 395,334; France 122,784; United States 73,076; Saudi Arabia 44,720.
Dolomite, all forms	22,437	24,169	Switzerland 4,412; Argentina 4,018; Austria 2,495.
Gravel and crushed rock	531,968	561,129	West Germany 127,193; Libya 101,337; Switzerland 92,708.
Limestone (except dimension)	67	90	NA.
Quartz and quartzite:			
Piezoelectric crystal kilograms	13,100	1,308	NA.
Other	41,576	37,393	Switzerland 15,568; France 12,538.
Sand excluding metal bearing	305,279	309,244	Switzerland 275,116.
Sulfur:			
Elemental, all forms	4,954	3,302	Yugoslavia 1,260; Cyprus 300.
Sulfur dioxide	96	407	NA.
Sulfuric acid	151,615	78,111	Turkey 46,075; Spain 8,555.

See footnotes at end of table.

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Table 2.—Italy: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Talc, steatite, soapstone	41,959	51,350	West Germany 16,343; United States 9,127; United Kingdom 8,074; France 5,607.
Other:			
Slag, dross and similar waste, not metal bearing	317,327	229,111	Yugoslavia 192,945.
Oxides, hydroxides, peroxides of magnesium, strontium, barium	1,962	9,417	Yugoslavia 4,100; Netherlands 3,116.
Building materials of asphalt, asbestos and fiber cement, and unfired nonmetals, n.e.s	105,929	149,872	France 53,078; Libya 37,541; West Germany 9,162; Morocco 4,869.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	1,692	1,937	Libya 1,670.
Carbon black and gas carbon	33,573	38,199	Austria 8,320; Turkey 7,259; France 4,679; Yugoslavia 4,609.
Coal, all grades, including briquets	4,253	5,226	Switzerland 3,594.
Coke and semicoke	796,979	825,883	Romania 402,203; Spain 141,275; Algeria 81,491.
Peat	267	637	NA.
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	31,654	36,414	United Kingdom 8,224; Netherlands 5,708; Switzerland 3,866; France 3,599.
Kerosine do.	16,159	16,841	Greece 2,299; Libya 1,514; United Kingdom 1,449; Netherlands 997.
Distillate fuel oil do.	45,848	34,294	France 4,155; Switzerland 4,111; West Germany 3,556; Netherlands 3,482.
Residual fuel oil do.	39,407	44,702	United States 11,928; Turkey 1,764; Libya 1,343; France 1,316.
Lubricants do.	3,251	2,527	Belgium-Luxembourg 416; West Germany 258; Netherlands 216; Switzerland 180.
Other:			
Liquefied petroleum gas do.	3,828	5,660	Turkey 1,447; Egypt 1,206; Spain 643; Greece 454.
Mineral jelly and wax do.	8	16	West Germany 10; Poland 2.
Bitumen and other residues do.	1,127	1,248	Austria 600; Switzerland 261; Tunisia 170.
Bituminous mixtures, n.e.s do.	79	85	Malta 24; Libya 18; Tunisia 18; Yugoslavia 12.
Petroleum coke and pitch coke do.	138	116	Greece 50; France 50; Yugoslavia 11.
Total	141,499	141,903	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	125,650	53,768	France 45,118; Spain 8,486.

[r]Revised. NA Not available.
[1]Less than 1/2 unit.

Table 3.—Italy: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite	1,829,887	1,823,630	Australia 1,383,677; Guinea 319,681.
Ash and residue containing aluminum	35,218	NA	
Oxide and hydroxide	66,427	110,722	Guinea 51,000; France 24,816; West Germany 11,377.
Metal including alloys:			
Scrap	33,465	43,500	West Germany 11,467; France 8,049; Austria 7,121; Netherlands 5,802; Switzerland 5,675.
Unwrought	130,904	225,503	West Germany 70,326; Greece 42,754; France 38,544.
Semimanufactures	36,555	52,228	West Germany 18,833; France 11,822.
Antimony:			
Ore and concentrate	728	1,090	Canada 499; Turkey 299; Bolivia 272.
Metal including alloys, all forms	184	229	Belgium-Luxembourg 75; United Kingdom 51.
Arsenic trioxide, pentoxide, acids	1,531	1,118	People's Republic of China 564; France 278.
Beryllium metal including alloys, all forms kilograms	3,400	1,800	NA.
Bismuth metal including alloys, all forms	159	103	France 77.
Cadmium	143	260	West Germany 201.

See footnotes at end of table.

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Table 3.—Italy: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Chromium:			
Chromite	160,728	234,912	Turkey 119,291; U.S.S.R. 35,020; Republic of South Africa 34,402; Albania 29,604.
Oxide and hydroxide	2,001	2,010	West Germany 1,309.
Metal including alloys, all forms	143	178	France 98; Netherlands 30; United Kingdom 30.
Cobalt:			
Oxide and hydroxide	314	295	Belgium-Luxembourg 238.
Metal including alloys, all forms	282	255	Belgium-Luxembourg 107; France 45.
Columbium and tantalum:			
Ore and concentrate	235	5	NA.
Metal, all forms, including waste and scrap	25	(1)	NA.
Copper:			
Ash and residue containing copper	277	485	NA.
Copper sulfate	1,944	1,949	Yugoslavia 1,088; France 612.
Metal including alloys:			
Scrap	55,940	68,089	France 18,825; West Germany 14,938; United States 11,778; United Kingdom 10,584.
Unwrought	299,179	315,065	Zambia 63,473; Chile 59,453; Belgium-Luxembourg 46,737.
Semimanufactures	26,483	45,783	West Germany 16,208; Belgium-Luxembourg 7,852; France 5,299; Greece 5,019.
Gallium, indium, and thallium kilograms	1,300	1,000	NA.
Germanium do	800	500	NA.
Iron and steel:			
Ore and concentrate thousand tons	15,650	17,055	Brazil 3,196; Liberia 2,880; Australia 2,548; Canada 2,098.
Roasted pyrite do	1	3	NA.
Metal:			
Scrap do	5,414	6,272	France 2,619; West Germany 2,070; United States 621; U.S.S.R. 342.
Pig iron including cast iron and spiegeleisen do	662	712	Brazil 191; West Germany 118; France 113; U.S.S.R. 71; Algeria 67.
Sponge iron, powder and shot do	15	37	Brazil 16; Sweden 9; France 6; West Germany 4.
Ferroalloys:			
Ferromanganese do	125	117	France 52; Norway 6; Spain 6; Portugal 6.
Other do	120	152	West Germany 43; France 30; Norway 21; Yugoslavia 14.
Steel, primary forms do	1,481	2,543	France 624; West Germany 265; Australia 265; Brazil 194.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	468	728	France 203; Austria 79; Belgium-Luxembourg 67; West Germany 18.
Universals, plates, sheets do	1,054	1,504	France 555; Belgium-Luxembourg 211; West Germany 178; Austria 104.
Hoop and strip do	152	178	France 49; West Germany 36; Belgium-Luxembourg 21; Yugoslavia 10.
Rails and accessories do	77	66	West Germany 35; France 17; Netherlands 4.
Wire do	40	64	Belgium-Luxembourg 24; France 13; West Germany 12; Austria 5.
Tubes, pipes, fittings do	189	207	West Germany 72; France 58; Yugoslavia 23.
Castings and forgings, rough do	4	3	NA.
Total do	1,984	2,750	
Lead:			
Ore and concentrate	13,616	19,944	Poland 5,129; Greece 4,875; Canada 3,742.
Ash and residue containing lead	809	2,081	United States 1,493.
Oxide	3,391	3,678	France 1,317; Mexico 1,049.
Metal including alloys:			
Scrap	18,531	22,235	West Germany 5,909; France 5,672; United Kingdom 4,969.
Unwrought	129,511	157,345	West Germany 38,763; Australia 21,573; Mexico 18,028; Peru 14,943; Morocco 11,666.
Semimanufactures	640	977	NA.
Lithium	14	4	NA.
Magnesium metal including alloys:			
Scrap	795	1,643	West Germany 1,150; Netherlands 230.
Unwrought	230	141	Morocco 117; United Kingdom 10; West Germany 10.

See footnotes at end of table.

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Table 3.—Italy: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Magnesium metal including alloys —Continued			
Semimanufactures	145	195	United States 98.
Manganese:			
Ore and concentrate	315,382	355,919	Republic of Sourth Africa 186,038; Gabon 105,495.
Oxides	3,919	2,425	Belgium-Luxembourg 1,416; Japan 490.
Metal, all forms	1,921	1,756	Republic of South Africa 1,303; France 213.
Mercury 76-pound flasks	261	783	NA.
Molybdenum:			
Ore and concentrate	6,229	5,315	Netherlands 3,589; Belgium-Luxembourg 681.
Metal including alloys, all forms	92	262	Belgium-Luxembourg 120; Austria 52.
Nickel:			
Matte, speiss and similar materials	4,907	5,407	Canada 3,574; Cuba 943.
Metals including alloys:			
Scrap	833	1,450	Canada 698; Australia 147; Yugoslavia 145.
Unwrought	7,068	7,907	United Kingdom 2,411; Australia 731; United States 700.
Semimanufactures	2,324	2,251	West Germany 886; United Kingdom 561; United States 274.
Platinum-group metals and silver including alloys:			
Platinum group thousand troy ounces	434	364	West Germany 169; Republic of South Africa 56; United Kingdom 55.
Silver do	29,096	31,058	United States 10,320; United Kingdom 6,687; Belgium-Luxembourg 3,729.
Rare-earth metals:			
Oxides and other compounds value, thousands	$318	NA	
Metals:			
Cerium	4	10	NA.
Other	313	362	Austria 202; West Germany 143.
Selenium, elemental	25	33	Japan 13; West Germany 5.
Silicon, elemental	2,804	3,442	Republic of South Africa 1,431; France 1,357; Sweden 400.
Tellurium and arsenic	208	102	Sweden 63; United Kingdom 19.
Thorium value	$44	NA	
Tin:			
Oxide	35	13	NA.
Metal including alloys:			
Scrap	1	15	NA.
Unwrought	6,082	7,838	Malaysia 4,335; Indonesia 1,510.
Semimanufactures	138	171	NA.
Titanium:			
Ore and concentrate	102,929	161,272	Norway 138,080; Australia 23,059.
Oxides	26,049	39,026	West Germany 17,825; France 9,724.
Metal including alloys, all forms	r63	1,509	United States 739; U.S.S.R. 203; West Germany 151.
Tungsten:			
Ore and concentrate	240	108	Portugal 28; Republic of Korea 25; Austria 20; Mexico 20; United Kingdom 15.
Metal including alloys, all forms	63	91	France 27; West Germany 24.
Uranium metal	5	NA	
Vanadium oxide and hydroxide	527	397	Netherlands 185; Austria 175.
Zinc:			
Ore and concentrate	193,940	238,703	Canada 65,092; Peru 56,056; Greenland 28,357; Greece 25,849.
Ash and residue containing zinc	1,646	1,576	Switzerland 1,296.
Oxide and hydroxide	1,828	2,533	France 963; West Germany 589; Poland 320.
Metals including alloys:			
Scrap	2,971	2,565	West Germany 1,547; Belgium-Luxembourg 815.
Blue powder	1,752	53,569	Belgium-Luxembourg 13,689; West Germany 9,295; Zambia 7,821.
Semimanufactures	3,900	1,790	Belgium-Luxembourg 791; France 522; West Germany 403.
Zirconium:			
Ore and concentrate	34,530	44,440	Australia 43,229.
Metal including alloys, all forms kilograms	10,700	7,600	West Germany 4,600.
Other:			
Ore and concentrate	8,709	1,960	Australia 1,735.
Ash and residue containing nonferrous metals, n.e.s	4,146	4,952	France 378; Romania 208.
Oxides and hydroxides	4,404	6,790	Cuba 2,834; West Germany 1,466.
Metals including alloys, all forms:			
Metalloids	101	5	NA.
Alkali, alkaline earth and rare-earth metals, n.e.s	5,365	5,774	West Germany 4,237; France 1,468.

See footnotes at end of table.

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Table 3.—Italy: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Other —Continued			
Metals including alloys, all forms —Continued			
Pyrophoric alloys	10	14	Austria 6.
Base metals including alloys, all forms, n.e.s	4	12	Belgium-Luxembourg 10.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, etc	2,393	238,180	United Kingdom 134,113; United States 52,170; Algeria 39,602.
Dust and powder of precious and semiprecious stones value, thousands	$8,017	NA	
Grinding and polishing wheels and stones	3,551	3,200	Austria 956; United Kingdom 553; West Germany 526.
Asbestos	66,273	74,127	Republic of South Africa 25,602; Canada 22,171; U.S.S.R. 16,088.
Barite and witherite	9,055	7,729	France 6,010.
Boron materials:			
Crude and natural borates	147,648	125,778	Turkey 89,298; United States 26,913.
Oxide and acid	180	3,552	Turkey 2,275; United States 856.
Cement	59,282	217,732	Algeria 74,171; Libya 66,152; France 42,196.
Chalk	12,958	14,841	France 13,968.
Clays and clay products:			
Crude:			
Bentonite	23,418	41,471	Greece 30,556.
Kaolin	430,842	558,598	United Kingdom 291,478; United States 133,716.
Other	595,119	706,347	France 256,529; West Germany 227,007.
Products:			
Refractory	183,322	158,285	United Kingdom 43,460; West Germany 37,051; Austria 28,874.
Nonrefractory	21,221	16,938	West Germany 10,788; France 3,969.
Cryolite and chiolite	317	256	All from Denmark.
Diamond:			
Gem, not set or strung value, thousands	$9,129	$14,718	Belgium-Luxembourg $9,228; Netherlands $1,746; Israel $1,585.
Industrial do	$3,488	NA	
Diatomite and other infusorial earths	2,973	3,238	United States 772; West Germany 745.
Feldspar	18,708	18,105	Norway 8,907; West Germany 3,778; Portugal 1,965.
Fertilizer materials:			
Crude thousand tons	1,668	1,561	Morocco 1,114; Jordan 119; United States 72.
Manufactured:			
Nitrogenous	60,314	69,136	West Germany 23,302; Czechoslovakia 9,489; United States 8,817.
Phosphatic	177,870	167,382	Tunisia 43,136; France 37,316; Spain 32,610; United States 31,108.
Potassic	273,437	321,098	Israel 94,171; France 71,420; U.S.S.R. 52,440; East Germany 46,733.
Other	311,172	454,666	United States 333,182; Yugoslavia 54,244; Canada 29,483.
Ammonia	39,412	141,334	Austria 37,756; Kuwait 34,199; Venezuela 19,850.
Fluorspar	36,066	42,094	Mexico 16,803; Tunisia 8,220; Morocco 5,500; France 5,215; Spain 4,278.
Graphite, natural	3,287	4,735	West Germany 2,547.
Gypsum and plasters	8,997	14,545	Austria 11,490.
Lime	99	103	NA.
Lithium ore	772	643	NA.
Magnesite	58,740	61,017	Greece 40,268; Yugoslavia 6,237.
Mica:			
Crude, including splittings and waste	955	1,072	Republic of South Africa 200.
Worked, including agglomerated splittings	296	309	Belgium-Luxembourg 69; Spain 61; France 60.
Pigments, mineral, iron oxides	11,782	19,130	West Germany 13,173; Netherlands 1,386; Czechoslovakia 1,098.
Precious and semiprecious stones, except diamond:			
Natural value, thousands	$409	NA	
Manufactured kilograms	8,163	7,483	Switzerland 3,426.
Pyrite (gross weight) thousand tons	317	152	U.S.S.R. 115; Cyprus 27.
Salt	41,212	139,435	U.S.S.R. 69,496; Tunisia 51,423.
Sodium and potassium compounds	90,041	117,789	West Germany 34,964; France 31,637; Netherlands 22,975; Belgium-Luxembourg 19,205.

See footnotes at end of table.

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Table 3.—Italy: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous including marble	116,812	140,350	Portugal 32,410; Yugoslavia 31,022; Pakistan 16,113; Iran 14,691; Greece 14,049.
Slate	1,887	2,308	NA.
Other	160,768	192,777	Republic of South Africa 58,328; Norway 23,360; Sweden 21,149; Finland 19,652.
Worked, all forms	1,708	2,722	France 760; West Germany 660; Spain 386.
Dolomite	1,431	1,448	NA.
Gravel and crushed rock	8,537	10,363	Yugoslavia 3,464; France 3,101.
Limestone (except dimension)	78	1,741	NA.
Quartz and quartzite:			
Piezoelectric crystal ____ kilograms	75	449	Japan 287.
Other	58,937	60,203	Portugal 21,030; West Germany 9,492.
Sand, excluding metal bearing thousand tons	976	1,048	France 541; Belgium-Luxembourg 378.
Sulfur:			
Elemental, all forms	559,291	560,256	Canada 351,744; Poland 66,603; France 60,373.
Sulfuric acid	47,793	4,196	Austria 3,226; West Germany 801; Belgium-Luxembourg 48.
Talc, steatite, soapstone, pyrophyllite	14,667	18,290	Austria 10,256; France 3,184; Belgium-Luxembourg 1,484.
Other:			
Slag, dross and similar waste, not metal bearing	24,602	22,792	Austria 5,202; Algeria 4,303.
Oxides and hydroxides of strontium, barium, and magnesium	3,628	3,554	West Germany 1,170; France 935; Japan 520; United States 447.
Building materials of asphalt, asbestos and fiber cement, and unfired nonmetals, n.e.s	18,615	19,233	Canada 5,360; Belgium-Luxembourg 3,532; France 2,955.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen	1,891	1,463	United States 1,212; Albania 150.
Coal and briquets:			
Anthracite and bituminous coal thousand tons	12,314	11,694	United States 3,475; Poland 3,168; West Germany 2,315; U.S.S.R. 1,223.
Briquets of bituminous coal and anthracite do.	17	6	France 4; West Germany 2.
Lignite and lignite briquets do.	68	79	Yugoslavia 38.
Coke and semicoke do.	155	145	France 89; West Germany 52.
Peat do.	26	32	U.S.S.R. 20; West Germany 6; Poland 2.
Gas, natural:			
Gaseous million cubic feet	NA	336,835	U.S.S.R. 176,758; Netherlands 160,077.
Liquefied thousand 42-gallon barrels	NA	20,230	All from Libya.
Petroleum:			
Crude and partly refined do.	661,101	743,607	Saudi Arabia 197,752; Libya 126,584; Iraq 109,537; Iran 101,942.
Refinery products:			
Gasoline do.	13,974	15,478	U.S.S.R. 4,076; Saudi Arabia 2,931; Kuwait 1,704; Belgium-Luxembourg 1,133.
Kerosine do.	1,023	713	U.S.S.R. 311; Trinidad and Tobago 196; France 159.
Distillate fuel oil do.	7,487	8,758	U.S.S.R. 2,809; France 1,128; Netherlands 755.
Residual fuel oil do.	52,394	52,401	Venezuela 10,805; U.S.S.R. 6,940; France 6,485; Greece 4,462.
Lubricants do.	899	915	United Kingdom 237; West Germany 190; United States 189.
Other:			
Liquefied petroleum gas do.	71,147	2,486	France 660; West Germany 362; Venezuela 254; Switzerland 117.
Mineral jelly and wax do.	346	368	West Germany 98; Hungary 75; U.S.S.R. 47; People's Republic of China 34.
Bitumen and other residues do.	1,479	1,357	United States 861; Albania 455.
Bituminous mixtures, n.e.s do.	30	9	United Kingdom 4; United States 2.
Petroleum coke and pitch do.	3,691	3,361	United States 2,085; Argentina 336.
Total do.	152,470	85,846	
Mineral tar and other coal, petroleum, or gas derived crude chemicals	193,399	263,957	United States 170,534; Spain 29,600; Romania 16,154.

[r]Revised. NA Not available.
[1]Less than 1/2 unit.

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Table 4.—Mineral trade with the United States, 1976[1]

Commodity	Exports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
METALS				
Aluminum metal including alloys	3,775	$4,940	4,869	$10,331
Copper metal including alloys	3,304	4,032	14,273	24,174
Iron and steel:				
Iron ore and concentrate	3,475	103	--	--
Metal:				
Scrap	20	13	656,597	64,731
Pig iron	459	412	--	--
Ferroalloys	1,455	973	1,069	730
Steel, primary forms	--	--	1,830	785
Semimanufactures:				
Bars and angles	19,356	10,328	20,082	6,266
Plates and sheets	244,027	58,416	44,350	11,268
Hoop and strip	50	69	330	912
Rails	--	--	300	153
Wire	1,043	506	296	588
Tubes and pipes	18,628	8,514	4,251	7,861
Castings and forgings	5,019	2,051	161	1,293
Lead metal including alloys	NA	1	104	85
Mercury	456	1,252	--	--
Molybdenum ore and concentrate	1	7	277	3,339
Nickel metal including alloys	--	--	20	110
Platinum-group metals and silver:				
Ore and concentrate	9	1,241	8	305
Platinum group	NA	891	(2)	235
Radioactive and associated materials	4	48	122	10,800
Silver	NA	9	--	--
Tin metal including alloys	NA	2	NA	1
Uranium and thorium:				
Concentrates	--	--	103	2,556
Uranium metals including alloys	--	--	2	34
Zinc metal including alloys	28,013	18,875	43	52
Other nonferrous metals:				
Ores and concentrates	--	--	10	20
Base metals including alloys, n.e.s	611	1,347	930	4,546
Scrap	1,443	729	16,227	11,866
NONMETALS				
Abrasives, natural, including diamond	50,727	406	2,973	4,029
Cement	176	17	587	159
Clays and refractory materials	98	19	165,118	
Diamond and precious stones	17	3,994	11	308
Fertilizer materials:				
Crude, phosphatic	--	--	95,658	3,157
Ammonia, anhydrous	--	--	7,257	665
Quartz, mica, feldspar, etc	52,814	4,400	--	--
Salt, sodium chloride	(2)	2	--	--
Stone, dimension	1,919	158	2,322	538
Sulfur:				
Sulfur and unroasted pyrites	1	1	--	--
Sulfuric acid	--	--	3	4
Other, crude	10,683	1,079	738	353
MINERAL FUELS AND RELATED MATERIALS				
Asphalt, natural	--	--	1,135	178
Coal, all types	--	--	3,780,362	218,453
Petroleum:				
Crude and partly refined	166,588	19,446	--	--
Refinery products:				
Gasoline	129,924	16,723	--	--
Residual fuel oil	1,911,938	137,875	--	--
Lubricants	41	61	25,336	7,264
Petroleum jelly and mineral waxes	11	4	878	686
Petroleum coke, asphalt, etc	31,838	4,459	593,670	36,916
Total	XX	303,403	XX	448,436

NA Not available. XX Not applicable.
[1]Data may differ from those reported elsewhere in this chapter owing to a different source.
[2]Less than 1/2 unit.

Source: U.S. Department of Commerce, Bureau of the Census.

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The United States had a negative mineral trade balance with Italy. Coal accounted for almost one-half of the value of imports from the United States, while residual fuel oil was the most valuable item exported to the United States. Table 4 gives details of mineral trade between the two countries in 1976.

COMMODITY REVIEW

METALS

Aluminum.—The aluminum sector of the Italian mineral industry operated on imported raw materials during 1977. Domestic output of bauxite, about 35,000 tons per year, supplied only slightly over 1% of total bauxite consumption. Although Italy produced about 260,000 tons each of primary aluminum and 225,000 tons of secondary aluminum, it was a net importer of aluminum.

No major events were registered in the aluminum sector. Six plants, with a total annual capacity of approximately 291,000 tons of primary aluminum, were in operation during 1977, of which the largest was the smelter at Porto Vesme, Sardinia. The following tabulation shows details on aluminum plants operating in Italy.

Company	Location	Annual 1977 capacity (thousand metric tons)
Alumetal S.p.A	Bolzano	50
Do	Fusina	36
Do	Mori (Trento)	20
Societa Alluminio Veneto per Azioni S.p.A.	Fusina	30
Do	Porto Marghera	30
Aluminio Sardo S.p.A	Porto Vesme, Sardinia.	125
Total		291

Iron and Steel.—Although the steel industry of Italy faced financial problems and the year 1977 was considered poor, steel companies were preparing to resume full-capacity production when the economic slowdown ended.

Italsider S.p.A. announced a decision to replace six open hearths with two 250-ton-per-year converters at the Oscar Sinigaglia Steelworks, Cornigliano (Genoa). Replacement should be completed by September 1979, and new steel capacity should reach 2.4 million tons per year. In addition, at the Cornigliano iron and steel works, Italsider committed several hundred million dollars to new and improved facilities, including a rebuilt blast furnace, a new continuous two-strand casting plant, and additions to the cold-rolling mill.

At Dalmine, Dalmine S.p.A. (of the Finsider Group) completed one 80-ton electric arc furnace, replacing an open hearth furnace. At the Piombino plant, also operated by Dalmine, construction continued on two new mills: A billet mill and a two-strand-wire rod mill.

Fiat S.p.A., one of Italy's major privately owned steel producers, regrouped its steelmaking activities under the name Teksid and started negotiating with the Government on a possible takeover of Breda Siderurgica S.p.A.'s and Soc. Nazionale Cogne's installations.

During 1977, as in the past, the steel industry of Italy was almost completely dependent on imported iron ore, and all of its requirements for coking coal had to be met through imports. The annual production capacity in 1977 was 17.1 million tons of pig iron and 34.8 million tons of steel. More than two-thirds of the steel capacity was in electric furnaces and Linz-Donawitz (basic oxygen) converters. Capacity utilization was about 67%. The major producer, the Government-owned Finsider Holding Group, produced 55% of Italy's steel output. During 1977, most major companies of the Finsider Group registered losses.

In the private sector, Acciaierie e Ferriere Lombarde Falck S.p.A., the second largest steel producer in Italy, distributed dividends.

Lead and Zinc.—Output of lead and zinc mines in Italy remained at about the same level during 1977 as in 1976. At the Montiponi mine, operated by Soc. Ricerca Gestione Ristrutturazione Miniere, Sarde (Sogersa), treating of old tailings started. The high water levels in workings interfered with production. At the Salafossa mine in northeastern Italy, operated by Soc. Mineraria e Metallurgica di Pertusola (Pertusola), exploration continued and discovery of a new ore body was announced. The new find is separated from the main deposit by a fault. Quality of ore was not reported, but reserves of about 1 million tons were implied.

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The expansion of Pertusola's Crotone electrolytic zinc plant to 130,000 tons per year continued, and startup was scheduled for 1979 or 1980.

Zinc producers, particularly Pertusola, successfully concluded a legal battle against electric power suppliers who increased prices of electricity delivered to zinc electrolytic plants. The courts ordered a rollback of prices paid for this electricity.

In the Masua mine in Sardinia, operated by AMMI Sarda S.p.A., exploration continued. In addition, a new flotation plant with a capacity of 2,500 tons per day of ore came onstream.

Pyrite.—Operations at the new Campiano (Grosseto) mine, operated by Solmine S.p.A., were delayed by an influx of hot underground water, causing several months' delay until new pumps were installed. The largest producers of pyrite were the Niccioleta and Gavorrano mines, belonging to Solmine; both of these had to lower production during 1977 owing to a shortage of miners.

Titanium.—A deposit of titanium ore was discovered at Mount Beigna, near Varazze (Savona) by geological teams exploring for the companies holding the concession, the privately owned Soc. Metallurgica Italiana (SMI) and the State-owned Soc. Ricerca Mineraria (RIMIN). Reports indicated a large deposit with a metal content that would make operation of it economical. The ore body is located in a scenic area and attempts to start production would probably generate strong opposition.

At present, Italy imports about 200,000 tons of titanium ore per year from Norway, Australia, and Malaysia. A recent forecast set Italy's needs for titanium ore at 250,000 tons by 1980.

Rutile.—Exploration of the newly discovered Piampaludo rutile deposit in Liguria, owned by Mineraria Italiana S.p.A., could make Italy the first producer of rutile in Europe. At yearend 1977, proven reserves of hard-rock ore were reported at 150 million tons with an average rutile content of 3% to 5%. Another 400 million tons of ore was classified as resources. The project was in an early stage of development, with many unresolved problems, but a possible size for commercial operations was reported as 75,000 tons of rutile per year.

Italy has depended on imports of rutile to meet its demand, and production from the Piampaludo deposit could be useful.

Titanium ores were processed by Italsider at Lovere (Tassara di Berno), Italghisa Elettrosiderurgica di Bagnolo Mella, and Officine Elettrochimiche di Calusco d'Adda, all in northeastern Italy.

NONMETALS

Barite.—High unemployment and poverty in Calabria have led the Government to consider reopening the barite mine and plant near Catanzaro (Calabria), closed 4 years ago. In the past, barite facilities in Catanzaro were operated by Industrie Minerarie Meridionali S.p.A., and production ranged between 5,000 and 10,000 tons of white air-floated barite used in the paint industry. At yearend 1977, the decision to go ahead with the reopening had not been made. Reorganization of the Italian mining industry after EGAM's demise was mentioned as the main cause for the delay.

Italy produced barite from 18 mines; the largest producers were in the Province of Cagliari, in Sardinia. The country was a net exporter of barite, but the trend of production continued downward because of technical and financial difficulties and labor problems.

Clays—*Bentonite.*—Under pressure to close its unprofitable bentonite operations on the Island of Ponza, northwest of Naples, the Italian bentonite producer, S.A. Mineraria Isole Pontine (SAMIP), was actively exploring a number of other bentonite deposits in Italy. Most efforts went into exploration of deposits near Nuoro (Sardinia).

The principal bentonite deposits are located in Sicily and Sardinia, near Rome, and in Campobasso Province. Italy was a net importer of bentonite during 1976, the latest year for which complete data are available.

Cement.—The cement industry had an uneventful year. The number of plants in operation remained at 120. Total cement plant capacity was 72 million tons per year. Italcementi S.p.A. was the most important cement producer in the country, with about 37% of Italy's output. Italcementi's largest plants were located at Bergamo, Brescia, and Colleferro.

As in the past, Italy was a net exporter of cement in 1976, the latest year for which complete data are available. Raw materials for cement production were abundant in Italy.

Fertilizer Materials—*Potash.*—Potash was mined in Sicily, and exploration, with apparently positive results, was underway

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near Milena, Vallone, and Realmonte, in the vicinity of Porto Empedocle. Industria Sali Potassici e Affinie (ISPEA), owned by the Federal and Sicilian Governments, remained the major company exploring for and producing potash in Italy.

Fluorspar.—During 1977, reduced output of fluorspar resulted from lower demand and keener competition from countries with lower labor costs and export incentives.

Fluorite was produced in Sardinia and in Lombardy, in the northern part of the Italian mainland. The largest Italian producers were Gruppo Aziendale Mineraria Silius S.p.A., operating in Sardinia, and Fluormine S.p.A., operating in northern Italy. Italy was self-sufficient in fluorspar, and imports and exports were of the same order of magnitude.

Olivine.—Cives Industria Estrativa of Savona, which operates an olivine mine and dry-processing plant at Vidracco near Valchiusella, about 50 kilometers north of Turin, was installing new dust extraction and air classification equipment. In addition, plans were prepared for a new warehouse and washing plant.

Until 1968, the bulk of Italy's olivine demand was met through imports. Austria and Norway were the principal suppliers. With development of the deposit at Vidracco and startup of the mine and dry plant, both now rated at 80,000 to 90,000 tons per year of foundry sand (on a single-shift basis), imports of olivine have been lowered substantially.

Salt.—Salt output remained static owing to lower demand by the depressed chemical industry, the principal consumer.

Salt was produced in four forms in Italy: Rock salt, salt in brine, solar salt, and vacuum salt. Rock salt, the major source of salt, was produced around Agrigento and Caltanissetta in Sicily, where 10 separate mines, operated by Soc. Salitaliana, had a capacity of 2 million tons of salt per year. Salt in brine was produced by Solvay & Cie. S.p.A. from solution mining of rock salt near Rosignano Marittimo in Tuscany. The State monopoly, Administrazione Autonoma dei Monopoli di Stato, produced salt in brine at Volterra, also near Rosignano Marittimo, but the brine was used for production of vacuum salt. Facilities for solar salt production were scattered around the country. Most was produced by the State monopoly, which owned the solar salt works at Margherita di Savoia on the Adriatic coast and two plants near Cagliari (Sardinia). Rumianca S.p.A. operated a third solar plant in the vicinity of Cagliari. The most important vacuum salt operation was the 900,000-ton-per-year plant at Ciro Marina in Calabria, operated by Societa Salitaliana. The Ciro Marina plant gets brine, through a 40 kilometer pipeline from a rock salt deposit at Timpa del Salto.

Sulfur.—No major events were reported in the sulfur sector of the Italian mining industry. The largest producer was the Pomezia open pit mine, south of Rome, operated by COMIRO. Although uneconomical, eight Sicilian underground mines remained in production to provide employment.

Other.—Asbestos was produced in the San Vittore open pit mine near Turin; feldspar deposits in production were located near Bergamo, Commo, Vercelli, and Trento; graphite was mined near Turin; and talc output was recorded in Valle d'Aosta, also near Turin.

MINERAL FUELS

Coal.—Except for lignite, there was virtually no production of coal in Italy during 1977. Imported coking coal met the demand of metallurgical installations.

Lignite was produced at two mines, Santa Barbara and Pietrafitta, both near Perugia, operated by Ente Nazionale Energia Elettrica (ENEL). All lignite output was used for fueling ENEL's thermal powerplants.

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Table 5.—Italy: Supply and apparent consumption of fuels and power

(Million tons of standard coal equivalent[1])

	Total primary energy	Coal and coke	Petroleum and refinery products	Natural gas	Fuel wood	Hydroelectric power	Nuclear power
1975:							
Production	27.0	0.5	1.6	19.0	(2)	5.5	0.4
Imports	177.8	12.8	153.4	11.0	(2)	.6	--
Exports	21.3	.7	20.3	--	(2)	.3	--
Apparent consumption	183.5	12.6	134.7	30.0	(2)	5.8	.4
1976:							
Production	29.3	.6	1.6	20.9	(2)	5.4	.4
Imports	192.4	11.9	165.3	14.5	(2)	.7	--
Exports	29.6	.8	28.5	.1	(2)	.2	--
Apparent consumption	192.1	11.7	138.4	35.3	(2)	5.9	.4

[1]1 ton standard coal equivalent (SCE) = 7 million kilocalories.
[2]Less than 1/2 unit.

Petroleum and Natural Gas.—Exploration for hydrocarbons was intensive and rather successful; several discoveries, mostly gas, were made during 1977. However, new oil and gas derived from these discoveries will perhaps only slightly and temporarily improve the modest share of domestic production in Italy's energy supply.

Intensity of exploration was increased during 1977. A total of 71 wells, totaling about 230,000 meters depth, were drilled, roughly 28% more than in 1976. There were five offshore drilling rigs in operation, drilling mostly in the Adriatic Sea.

Agip Mineraria, with the well Settala I, discovered gas in shallow pay 18 kilometers east of Milan. During the test, the discovery well produced at a rate of about 500,000 cubic meters of gas per day from a depth of between 1,200 and 1,300 meters. In the Adriatic Sea, a consortium of Essence et Lubrificants de France (ELF), Azienda Generali Italiana Petroli S.p.A. (AGIP), ENI, the Montedison Group, and Petroprep of France announced an oil discovery in two exploratory wells in the Rospo Field, Italian exploration Zone B, near Tremiti Island. Reserves of crude oil (110° API gravity) were reported at 40 million tons. A production concession was represented, but production is not expected before 1980. Oil was discovered in the Nilde 2 well, located about 60 kilometers southwest of the town of Marsala at the southwestern tip of Sicily. However, further drillings and testings were necessary before the potential was known. In the Foggia area, an onshore test well drilled by Premiers Consolidated Oilfields Ltd., produced at a rate of about 100,000 cubic meters of gas per day.

During 1977, Zone F, the first offshore deepwater zone, was opened to exploration for oil and gas. Zone F, covering a total of 26,000 square kilometers offshore, extends along the coast from Reggio di Calabria in the Strait of Messina to a point approximately due east of Vieste in the Adriatic Sea. The State-owned ENI has already reserved 25% of Zone F for its own exploration, chiefly between Bari and the Strait of Otranto and from the town of Villapiana in the Gulf of Taranto to south of Siderno Marino in the Ionian Sea. There has been no drilling in Zone F; only seismic and other geological data have been gathered.

Production of oil and gas in Italy received an important boost from the start of regular production from the Malossa reservoir near Bergamo. The reservoir is one of the largest in Italy. The pay zone of highly fractured limestone is 800 meters thick and at the great depth of 5,600 to 6,400 meters. Bottom-hole pressures are rated at 15,000 pounds per square inch, and wellhead flow pressures are as high as 11,750 pounds per square inch. In addition, bottom-hole temperatures of 300° F and wellhead temperatures of 212° F have been recorded. Special high-pressure, high-temperature, noncorrosive wellhead equipment was installed at 11 producing wells in the Malossa area. During 1978, production of oil from this reservoir is expected to reach 1 million tons, with about 3.7 million cubic meters of gas per day. Peak output is projected at 2.5 to 3.0 million tons per year of crude and about 10 million cubic meters per day of gas. At this rate, the field will supply about 3% of domestic crude oil demand and 14% of domestic natural gas demand in 1979. The oil is 51° API gravity

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with no sulfur content.

During 1977, 31 petroleum refineries were in operation with a total installed capacity of about 211 million tons per year. ENI and private Italian companies owned about 73% of the total capacity. Foreign-owned international companies owned the rest. The largest domestic Italian operator was the Attilio Monti Group, which owned 17% of total Italian refinery capacity; ENI followed with 14%. Exxon Corp., with 10% of total refinery capacity, was the largest foreign producer in Italy. The largest refinery was at Milazzo (Sicily) with a capacity of 25 million tons per year, operated by Mediterranea Raffineria Siciliana Petrol: S.p.A.

Uranium and Nuclear Power.—The Government-owned AGIP awarded a contract to Hunting Geology and Geophysics Ltd. to assist in the location of uranium deposits in northern Italy. Hunting was to carry out an airborne spectrometer program by two helicopters specially modified for airborne geophysics; this part of AGIP's survey was to be completed in fall 1978.

AGIP continued development of a uranium deposit with reserves estimated at 500 tons of U_3O_8, near Novara (Bergamo). The beginning of production was planned for 1979.

[1]Physical scientist, Branch of Foreign Data.

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The Mineral Industry of Japan

By E. Chin[1]

In 1977, Japan's gross natural product (GNP) reached $692.8 billion in terms of current market prices.[2] In 1970 constant prices, the GNP increased from $336.2 billion in 1976 to $391.7 billion in 1977, a real growth of 5.5%. During 1960-73, the real growth of Japan's GNP averaged 8.1% annually. By 1974, Japan's economy suffered from excess industrial capacity as a result of decreased demand for its goods and merchandise in foreign markets following the world oil crisis in the fall of the previous year. In 1974, there was a negative growth rate of 1.3% for the economy; in 1975, Japan's industries began to rebound, posting a growth of 2.1%, and in 1976, real growth was 6.3%.

Throughout 1977, Japan's steel industry operated at about 70% production capacity. Output during the year was 102 million tons. Domestic demand for steel remained around 65.2 million tons, about the same level as in 1976. Private plant and equipment investments which accounted for nearly 50% of domestic demand for steel mill products, decreased from 20.5% of the GNP in 1973 to 15.1% in 1977. The slump in the shipbuilding industry, a major user, heavily reduced the demand for ship plates, further depressing the steel industry. To compensate for decreasing domestic demand, the industry sought to increase exports. There was a sizable increase in steel shipments to the People's Republic of China and other countries and especially to the United States. However, U.S. steelmakers voiced strong opposition to rising Japanese imports, and in December, the U.S. Government announced the decision to regulate imports of low-priced steel products.

In the nonferrous sector, Japan's aluminum smelters lost international competitiveness because of the high energy cost of imported fuels. Industry officials estimated that at a sales price of Y370,000 per ton of aluminum ingot, the smelter suffers a loss of Y20,000 to Y30,000 per ton. The Industrial Structure Council recommended to the Government drastic and stringent measures to rescue the ailing aluminum smelters (see "Aluminum"). The copper, lead, and zinc companies continued to face sluggish demand, price reductions, deteriorating profits, and swelling inventories. Banking institutions provided financing equivalent to Y30 billion for stockpile purchases until demand recovered. Meanwhile, Japanese participants in overseas mining ventures sought to curtail, postpone, or suspend operations until the world economic situation improved.

Japan relies on foreign fuels for 87.9% of its energy requirements. The supply of domestically produced energy was as follows, in percent: Hydroelectric power, 5.6; coal, 3.2; nuclear power, 2.1; and natural gas and domestic petroleum, 0.8. The bulk of the country's energy supply was imports of petroleum, coal, petroleum products, liquefied natural gas (LNG), liquefied petroelum gas (LPG), and natural gas, in that order.

In November 1975, the Cement Association of Japan formed an antirecession cartel to curb production as a means of coping with the prolonged decline in demand and, consequently, in price. By 1977, however, domestic sales were estimated to have returned to the relatively high level of around 69.5 million tons, compared with 76.7 million tons in 1973. To cover the slump in domestic sales, producers had pursued export sales which reached 6.5 million tons in 1977, an increase of 15% over those of 1976. The industry expects that the expanded national budget will help spur cement demand in public works projects in 1978.

In a survey by the Ministry of Construction at the end of March 1977, there were 428,363 registered construction companies, but the industry is dominated by 5 compa-

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nies. Since 1973, there has been a sharp fall in private construction investments. Many of the companies turned to overseas markets to overcome poor domestic business conditions. The Overseas Construction Association of Japan, Inc., estimated that the number of foreign construction contracts awarded in 1977 rose 4.5% compared with that of 1976, to Y393,665 million. The Ministry of Construction, however, expected orders to decline, largely because of rising competitiveness from firms of the Republic of Korea.

Producers of chemicals and chemical fertilizers continued to be plagued by high energy costs, loss of international competitiveness, and the rising value of the yen. Industry and Government were developing plans to aid the industry through structural improvements, including plant scrapping. The chloralkali industry was encumbered by capital investments of Y240 billion in a switchover to diaphragm cells to prevent pollution. Japan is the world's largest fertilizer exporter but was facing stiff competition from newly established fertilizer plants in other countries and the unexpected yen appreciation.

Japan was one of the first nations to recover from the worldwide economic slump in the aftermath of the 1974 oil crisis. Its surpluses in trade and current accounts continued to rise annually from the low level in 1974 and dominate the country's overall balance of payments. Japan's favorable balance of trade had increased from $5.0 billion in 1975 to $9.9 billion in 1976, and then almost doubled to $17.3 billion in 1977. By yearend 1977, Japan's international oil reserves reached $22.8 billion compared with $16.6 billion at yearend 1976. Price movements accounted for a considerable part of the ballooning surplus. The yen quotation started the year at Y292.50=US$1.00; by February 9, the U.S. dollar equivalent reached Y285, then Y270 on April 12, Y260 on June 29, and Y263 on July 5; it stabilized between Y265 and Y266 from the latter part of July to the end of September, then reached Y260 on October 6, Y250 on October 28, and Y240 in December, subsequently hitting the year's high of Y238 and closing at Y240 at yearend.

Generally, the appreciation of the yen had two measurable effects on the domestic economy. According to an assessment by Japan's Economic Planning Agency (EPA), yen appreciation caused overall wholesale prices to decrease 18%. The study revealed that if the yen appreciated 10%, wholesale prices would drop by 3% and consumer prices 1% owing to the direct and indirect effects of the yen rise. Conversely, the yen appreciation distressed the export-oriented industries, causing cancellations of trade contracts. Many industries had been operating below capacity since 1974 and in 1977 were facing pressure owing to unemployment, unprofitability, and bankruptcy. As a result, many companies disposed of assets, such as land and stocks, and reduced or eliminated dividends.

Because of the prolonged business slump, corporations were weakened financially. Despite the dangers of mergers and corporate tie ups under depressed economic conditions, there were significant reorganizations in 1977. Osaka Iron & Steel Co., Ltd., and Ohtani Heavy Industry Co. formed a new company called Godo Steel Ltd. on June 1. Subsequently, Godo Steel Ltd., Nippon Satetsu Steel Co., and Koto Seiko Co. ratified an agreement to merge. C. Itoh & Co., Ltd., amalgamated with Ataka & Co. on October 1, becoming the nation's third largest general trader.

According to Teikoku Koshinsho and Tokyo Research, there were 18,471 business failures among firms with more than Y10 million liabilities, amounting to about Y2,980 billion in total liabilities. In March, Mie Shipyard filed under the Corporate Rehabilitation Law, becoming the first major shipbuilding company to fail. By far the largest bankruptcy in 1977 was Hashihama Shipbuilding Co. with liabilities running up to Y50 billion.[3]

Unemployment remained around 1 million, or about 2% of the work force, an unusual situation for Japan in which lifetime employment is an established practice. Surplus employment (the portion of employment which is not needed but is retained because of Japan's employment tradition) was estimated at several million. Slumping industries made employment adjustments in the form of personnel transfers to related firms. Mitsubishi Heavy Industries Ltd. transferred personnel to Mitsubishi Motor Corp. in 1976; and two transfers were made in 1977 in greater numbers. Sumitomo Metal Industries Ltd., and Kawasaki Steel Corp. also transferred personnel to the automotive sector during the year. Other corporations continued to be faced with a surplus of workers and were planning to cut back on

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their work force during the next year.

Because of the protracted economic outlook domestically and abroad, Japanese corporations continued to be cautious with foreign investments. Investments in Europe leveled off and those in North America declined, and investments in Asia, Africa, the Middle East, and Latin America rose. Southeast Asia accounted for $1,245 million in investments; North America, $749 million; Latin America, $420 million; Europe, $337 million; and the Middle East, $278 million. Indonesia was the recipient of the largest share, $3 million, largely owing to a large LNG project, followed by the United States and Brazil. These three countries together accounted for about $1,862 million or about 53.8% of the year's overseas investments. Most of the foreign investments were in the manufacturing sector, including electrical machinery, chemicals, iron and steel, and nonferrous metals. The mining industry accounted for $995 million in foreign investments, an increase of 40.7% above the previous year.

Japan was the world's third largest plant exporter, after the United States and the Federal Republic of Germany. Exports of industrial plants, including fees for engineering services, were estimated to have reached $10 billion in 1977, compared with $8 billion in 1976. In late 1977, the Republic of Korea's Pohang Iron and Steel Co. (POSCO) awarded a Y100 billion order to several Japanese firms, including Y50 billion to the group of Mitsubishi Heavy Industries, Mitsubishi Electric Corp., Ishikawajima-Harima Heavy Industries Co. (IHI), Ube Industries Ltd., Chugai Ro Kogyo Kaisha Ltd., and Mitsubishi Corp. for a hot-rolling mill; Y20 billion to the IHI/Mitsui & Co., Ltd., group for a blast furnace; Y10 billion to the Kawasaki Heavy Industries Ltd./C. Itoh group for a convertor; and Y7 to Y8 billion to the group of IHI, Tokyo Shibaura Electric Co., Kurita Water Industries Ltd., and Toyo Menka Kaisha Ltd., for power generation plant and water treatment facilities. POSCO also contracted orders for port and harbor facilities with the Sumitomo Heavy Industries, Ltd., and the Marubeni Corp. group and for raw materials processing facilities with the group of Nippon Conveyor Co., Mitsui Miike Machinery Co., and Toyo Menka Kaisha. Other large industrial plant orders included a Y100-billion petrochemical plant for the German Democratic Republic placed with the Toyo Engineering Corp./Mitsui & Co. group; a Y95-billion cement plant for Saudi Arabia with the IHI/Nichinen Co. group; and a Y64-billion seawater desalination plant for Iran with the group of Mitsubishi Heavy Industries, Sasakura Engineering Co., and Sumitomo Shoji Kaisha Ltd.

The Japan Machinery Federation estimated that sales of ocean development equipment (particularly overseas sales of rigs and other oil drilling apparatus) reached Y328.2 billion in 1977, up 33.6% compared with the year before. Moreover, oil drilling rigs owned by Japan Drilling Co. and Japan Odeco S.A. were in full operation in waters near Japan and in offshore areas of the Middle East and Latin America. In other ocean-development-related projects, Sumitomo Shoji Kaisha and other Sumitomo-group enterprises joined International Nickel Co., Ltd. of Canada in experimental mining of manganese nodules off Hawaii in the fall. Additionally, the Ministry of International Trade & Industry (MITI) placed an order with a local shipbuilder in December for a special survey ship to search for manganese nodules. The ship, slated for completion in 1980, was scheduled to start exploration in the mid-1980's.

Scientific and technological research expenditures by the Government, academic community, and industrial firms totaled Y3,320.6 billion in 1977, up 11.6% from those of the previous year. Of the total, private corporations accounted for Y1,882.2 billion, of which about 92% was spent by industrial, electric, chemical, and transportation manufacturers. Research activities funded by colleges and universities totaled Y934 billion, and by the Government, Y504.4 billion. Research expenditures, by type of activity, included Y130 billion for nuclear energy development, Y118 billion for information processing, Y107.8 billion for environmental protection and pollution control, Y79.5 billion for aerospace development, and Y18.3 billion for ocean research and development.

The value of Japan's imported industrial technology, as measured by the annual value of compensation payments, is about 0.5% of the GNP. Currently, 57.7% of all industrial technological processes were developed domestically, compared with 4.8% completely imported technology. The remainder were either refined versions of imported processes or a combination of imported and domestic technology. In some respects, Japanese technology in steel pro-

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duction, automobile manufacturing, and shipbuilding has surpassed that in many Western nations. Also, production technology for textiles, electrical machinery and appliances, and ceramics is considered very high by world standards. However, technology employed by Japan's producers of nonferrous metals, pulp and paper, and chemicals is considered generally below the levels of other industrialized nations.

PRODUCTION[4]

Japan is much more important as a consumer of raw materials and as a producer of intermediate and finished products than as an ore producer. Japan's production of clays, dolomite, limestone, and other aggregates for construction raw materials is only of minor significance. Domestic mine output of iron ore, copper, gold, silver, manganese, tin, lead, zinc, salt, and magnesia is supplemented by large imports to meet Japan's requirements in the production of value-added goods. Moreover, the aluminum industry is wholly dependent on imports of bauxite and alumina for metal production.

To meet the country's energy needs, virtually all forms of mineral fuels were imported to sustain Japan's industries. Domestic production of crude oil was less than 675,000 kiloliters, compared with imports of 265.0 million kiloliters. Imports of 1.5 million tons of anthracite coal compared with domestic production of 25,000 tons. Bituminous coal production was about 18 million tons; 59.6 million tons was imported mainly from the United States, Australia, and Canada.

In terms of mineral and metal processing, however, Japan's industries were very prominent, and output of refined metals and minerals products is large by world standards.[5] Japan ranked among the world's top three producers of iron and steel, aluminum, copper, zinc, cement, fertilizers, coke, and refined oil. It was also a major producer or the leading producer of lesser metals and minerals such as bismuth, cadmium, indium, selenium, silicon, tellurium, lime, seawater magnesia, talc, and pyrophyllite. In addition, Japan's output levels of lead, industrial gases (argon, nitrogen, and oxygen), and halogens (bromine and iodine) were among the top 10 in world production.

Production levels in mining and manufacturing in Japan recovered from the oil crisis of 1973, but industrial output has not regained the peak level of 1970-73. Indices of industrial production (1975=100) by major mineral-related sectors were as follows:

Sector	1973	1974	1975	1976	1977
Mining	112.8	105.8	100.0	100.0	103.1
Manufacturing	117.0	112.4	100.0	111.2	115.7
Iron and steel	118.8	116.9	100.0	109.5	108.1
Nonferrous metals and products	128.6	112.6	100.0	119.3	125.0
Fabricated metal products	133.4	123.0	100.0	116.8	124.9
Ceramic, stone, and clay products	126.5	117.0	100.0	110.4	115.2
Chemicals	110.2	109.9	100.0	111.5	117.2
Petroleum and coal products	106.6	104.4	100.0	102.7	104.7
Construction materials	130.5	115.5	100.0	109.6	110.0

In 1977, production of pig iron, crude steel, hot-rolled and cold-rolled ordinary steel products, and forged pieces was down from those of the previous year. There was a modest increase in output of hot-rolled specialty steel products, galvanized steel sheets, and iron castings. Production of electrolytic copper, rolled and extruded copper, and copper electric wire and cable increased compared with 1976 levels. The large increase in aluminum production was offset by growing industry stocks; cement output was up, and increased shipments resulted in lower inventory. Chemical fertilizer production was generally higher in 1977, as was production of soda ash and sulfuric acid; as opposed to output of fire brick, caustic soda, and titania decreased. Sales of petroleum refinery products were generally up during the year. Japan's overall supply of primary energy resources was up 5% in 1977.

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Table 1.—Japan: Production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
METALS				
Aluminum:				
Alumina, gross weight		1,565	1,411	1,785
Metal:				
Primary:				
Regular grades		1,013	919	1,188
High purity		3	4	5
Secondary		424	526	575
Antimony:				
Oxide	tons	2,851	5,901	5,571
Metal	do.	2,523	2,207	1,302
Arsenic, white (equivalent of arsenic acid)	do.	60	60	--
Bismuth	do.	651	681	698
Cadmium	do.	2,657	[e]2,900	2,894
Chromium:				
Chromite, gross weight	do.	23,149	22,150	17,986
Metal	do.	2,739	2,417	2,743
Cobalt metal	do.	48	515	1,093
Columbium and tantalum: Tantalum metal	do.	11	42	[e]50
Copper:				
Mine output, metal content		85	82	81
Metal:				
Blister		821	1,002	1,127
Refined		819	864	934
Germanium:				
Oxide	tons	13	22	16
Metal	do.	16	16	13
Gold:				
Mine output, metal content	thousand troy ounces	144	138	170
Metal	do.	1,044	1,113	1,281
Indium metal	do.	[e]550	300	250
Iron and steel:				
Iron ore and iron sand concentrate		726	758	684
Roasted pyrite concentrate (50% or more Fe)		675	653	571
Metal:				
Pig iron and blast-furnace ferroalloys		86,877	86,576	85,886
Electric-furnace ferroalloys:				
Ferrochrome		486	464	399
Ferromanganese		650	632	527
Ferronickel		201	198	224
Ferrosilicon		327	313	291
Silicomanganese		435	373	334
Other[1]		31	24	24
Steel:				
Crude		102,313	107,399	102,405
Semimanufactures, hot-rolled:				
Ordinary steel		77,879	83,161	79,617
Specialty steels		7,955	9,885	10,304
Lead:				
Mine output, metal content		47	52	55
Metal, refined:				
Primary		194	219	221
Secondary		48	54	56
Magnesium metal:				
Primary	tons	8,709	11,190	9,416
Secondary	do.	9,227	7,396	7,613
Manganese:				
Ore and concentrate, gross weight		158	142	126
Oxide		42	33	29
Metal	tons	8,270	6,752	7,267
Molybdenum:				
Metal content of concentrate	do.	140	[e]140	182
Metal	do.	206	336	275
Nickel metal, primary	do.	13,019	24,010	24,139
Platinum-group metals:				
Palladium	troy ounces	14,751	18,089	22,716
Platinum	do.	6,065	8,706	9,737
Rare-earth metals:				
Lanthanum oxide	tons	21	80	109
Cerium metal	do.	239	301	NA
Selenium, elemental	do.	417	460	456
Silicon metal	do.	230	283	289
Silver:				
Mine output, metal content	thousand troy ounces	8,733	9,299	9,646
Metal, primary	do.	31,985	36,522	38,184
Tellurium, elemental	tons	[r]33	23	[e]70
Tin:				
Mine output, metal content	do.	659	643	604
Metal:				
Primary	do.	1,212	1,144	1,280
Secondary	do.	46	91	42
Titanium:				
Slag	do.	4,483	3,486	1,228

See footnotes at end of table.

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Table 1.—Japan: Production of mineral commodities —Continued

(Thousand metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS —Continued			
Titanium —Continued			
Metal—tons	7,582	6,346	6,395
Tungsten:			
Mine output, metal content—do	969	1,026	975
Metal—do	885	1,431	1,433
Uranium metal—kilograms	3,247	3,043	[e]3,000
Zinc:			
Mine output, metal content	254	260	276
Oxide	52	59	58
Metal:			
Primary	698	742	778
Secondary	63	34	26
NONMETALS			
Asbestos	5	8	7
Barite	38	54	56
Bromine, elemental[e]	11	12	12
Cement, hydraulic	65,517	68,712	73,138
Clays:			
Fire clay	1,178	891	902
Kaolin	206	226	227
Feldspar[2]	363	399	453
Fertilizer materials:			
Crude, potassic (potassium carbonate), gross weight	24	[e]25	324
Manufactured:			
Nitrogenous (N content)[3]	2,341	1,557	2,677
Superphosphates	520	535	607
Fluorspar, all grades[e]	8	10	10
Gypsum	187	65	1,000
Iodine, elemental—tons	6,813	6,954	6,100
Lime (quicklime)	9,172	9,176	9,022
Pyrite and pyrrhotite (including cupreous):			
Gross weight	1,096	958	1,110
Content	539	471	471
Salt, all types	1,012	1,021	1,056
Sodium and potassium compounds:			
Sodium carbonate	1,124	1,085	1,179
Sodium sulfate	294	313	324
Stone, crushed and broken:			
Dolomite	4,330	5,524	5,752
Limestone	143,857	147,530	154,507
Sulfur:			
Elemental[4]	2,285	2,510	1,078
Sulfuric acid	[r]5,997	6,103	6,390
Talc and related materials:			
Pyrophyllite	1,073	1,692	1,226
Talc	118	105	128
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	370	409	[e]425
Coal:			
Anthracite	92	38	[e]25
Bituminous[5]	18,907	18,359	18,200
Lignite	61	53	[e]40
Total	19,060	18,450	18,265
Coke:			
Metallurgical coke	44,789	43,446	[e]43,000
Metallurgical breeze coke	2,557	2,181	[e]2,000
Gashouse coke including breeze	4,586	4,131	[e]4,000
Fuel briquets, all grades	633	466	[e]450
Gas, natural:			
Gross[6]—million cubic feet	99,000	101,000	110,000
Marketed—do	97,815	99,720	108,945
Natural gas liquids:			
Natural gasoline—thousand 42-gallon barrels	37	37	[e]37
Liquefied petroleum gas from natural gas (field plants only)—do	222	293	[e]300
Peat[e]	70	70	70
Petroleum:			
Crude—thousand 42-gallon barrels	4,433	4,241	4,334
Refinery products:			
Gasoline:			
Aviation—do	229	198	157
Other—do	129,766	187,923	196,317
Jet fuel—do	20,950	22,102	24,077
Kerosine—do	129,718	151,567	183,405
Distillate fuel oil—do	215,094	230,939	114,870
Residual fuel oil—do	690,005	674,246	803,850

See footnotes at end of table.

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Table 1.—Japan: Production of mineral commodities —Continued

(Thousand metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS —Continued				
Petroleum —Continued				
Refinery products —Continued				
Lubricants	thousand 42-gallon barrels	12,810	13,713	14,221
Other:				
Asphalt and bitumen	do.	25,746	24,972	28,103
Industrial gasoline	do.	--	1,607	--
Liquefied petroleum gas, n.e.s	do.	27,612	50,592	37,135
Naphtha	do.	165,718	180,897	126,796
Paraffin	do.	631	885	1,132
Petroleum coke	do.	1,340	1,143	1,730
Unfinished oils	do.	36,437	47,489	44,224
Refinery fuel and losses	do.	160,035	92,353	125,446
Total	do.	1,616,091	1,680,626	1,701,463

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]Includes (but not limited to) ferromolybdenum, ferrotungsten, ferrovanadium, and silicochromium.

[2]Includes aplite, as follows, in thousand tons: 1975—324; 1976—358; and 1977—411.

[3]Data are for years ending June 30 of that stated.

[4]Includes byproduct sulfur from sulfide ores and the petroleum industry. Native sulfur is no longer produced.

[5]Includes a small amount of natural coke.

[6]Includes output from gas mines and coal mines.

TRADE[6]

Japan's total foreign trade in 1977 was $151,598 million, compared with $131,865 million in 1976. The value of exports increased 9% to $80,476 million in 1977, and imports decreased 1% to $71,122 million. The value of imports during the first 5 months of 1976 exceeded that of exports. In 1977, Japan had a negative trade balance in January and February, with the value of exports exceeding that of imports during the remainder of the year, resulting in a favorable trade surplus of $9,354 million for the entire year. Since 1970, Japan has had a trade deficit only in 1973-75, owing to the world oil crisis of 1973 and the ensuing worldwide recession.

Japan was a net importer of animal and vegetable products, hides, skins, apparel goods, wood, and paper products, jewelry, precious metals, and mineral products. Because of the country's advanced technology and strong industrial base, Japan was a net exporter of value-added goods. By value, the largest export category was vehicles, aircraft, vessels, and associated equipment, totaling $24,156 million. Exports of ferrous and nonferrous metals in various forms were valued at $14,175 million; exports of optical, audio, measuring devices, and precision instruments and apparatus, $5,792 million; exports of textiles, $4,606 million; and exports of chemicals, $3,453 million.

By region, shipments to the United States and Canada accounted for 27% of Japan's total exports, followed by Southeast Asia 21%, Western Europe 16%, the Middle East 11%, Latin America 8%, and Africa 6%. The United States continued to be the largest single market for Japanese products. Exports to the United States were valued at $19,674 million. The other principal export destinations were as follows, in million dollars: The Republic of Korea, 4,065; the Federal Republic of Germany, 2,779; Taiwan, 2,551; Liberia, 2,503; Australia, 2,338; Saudi Arabia, 2,331; Hong Kong, 2,317; the U.S.S.R., 1,956; the United Kingdom, 1,949; and China, 1,937.

Japan's receipts from the Middle East (mainly crude oil) accounted for 29% of the country's total imports; from the United States and Canada 22%, Southeast Asia 21%, Australia, New Zealand, and the Republic of South Africa 9%, and Western Europe 8%. The United States was the largest single supplier to Japan, exporting goods valued at $12,481 million. Other major exporters to Japan were as follows, in million dollars: Saudi Arabia, 8,538; Australia, 5,305; Indonesia, 5,020; Iran, 4,274; Canada, 2,900; Malaysia, 1,563; China, 1,546; and the Federal Republic of Germany, 1,501.

Mineral fuels continued to be the most important trade item for Japan, accounting for about 42% of the value of total imports in 1977. The value of the imported crude oil alone during the year was $22,579 million and was principally from Saudi Arabia ($6,996 million), Iran ($3,970 million), and the United Arab Emirates ($2,707 million). Imports of steam coal totaled 1,489,110 tons

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valued at $74.2 million. Major suppliers were Vietnam, China, the Republic of South Africa, North Korea, and the U.S.S.R., in that order.

The principal mineral imports in 1977 included bauxite, copper ore and concentrates, iron ore and concentrate, lead and zinc ores and concentrates, and nickel ore. Other large-volume import items were abrasives, caustic soda, clays, fertilizers, pyrite, and salt.

Table 2.—Japan: Exports of mineral commodities[1]

(Thousand metric tons unless otherwise specified)

Commodity	1975	1976	1977	Principal destinations, 1976
METALS				
Aluminum:				
Bauxite and concentrate ---------- tons	860	1,066	660	Republic of Korea 800; Taiwan 200.
Oxide (alumina) and hydroxide ----------	57	123	203	Republic of Korea 36; U.S.S.R. 28; Taiwan 22.
Fused alumina ---------- tons	5,290	8,820	11,175	Republic of Korea 4,160; Taiwan 3,730.
Metal including alloy, all forms ----------	r135	137	193	Republic of Korea 33; United States 21; Taiwan 8.
Arsenic trioxide, pentoxide, acids ------ tons	6	5	12	Taiwan 3; Indonesia 2.
Beryllium metal including alloys, all forms kilograms	91	188	223	Republic of Korea 98; Romania 80.
Bismuth metal including alloys, all forms -tons	362	306	302	Netherlands 127; United States 126.
Cadmium metal including alloys, all forms do	1,471	1,841	784	East Germany 606; Netherlands 580.
Chromium:				
Chromite ---------- do	364	2,089	2,805	Republic of Korea 1,074; Australia 1,002.
Oxide and hydroxide ---------- do	749	1,102	2,033	United States 444; Republic of Korea 303.
Cobalt oxide and hydroxide ---------- do	12	11	10	Republic of Korea 6; Taiwan 4.
Columbium and tantalum: Tantalum metal including alloys, all forms ---------- kilograms	8,971	14,934	45,469	West Germany 10,400; United States 4,292.
Copper:				
Ore and concentrate ---------- tons	4,799	--	--	
Copper sulfate ---------- do	r1,523	331	560	Taiwan 134; Thailand 61; West Germany 60.
Metal including alloys, all forms ----------	117	163	224	United States 37; Hong Kong 21; Republic of Korea 19.
Iron and steel:				
Ore and concentrate ---------- tons	--	5	12	All to Taiwan.
Metal:				
Scrap ---------- do	274,759	202,659	210,740	Republic of Korea 148,721; Thailand 36,394.
Pig iron, including cast iron ---- do	406,846	2146,331	2563,911	United Kingdom 57,163; Italy 43,200.
Sponge iron, powder, shot ---- do	7,995	9,739	10,602	Australia 2,193; Taiwan 1,923.
Ferroalloys:				
Ferromanganese ----------	131	122	49	United States 91; Netherlands 14.
Other ----------	129	89	27	United States 43; Netherlands 24.
Steel, primary forms ----------	6,360	5,669	4,659	Republic of Korea 836; Spain 782; United States 716.
Semimanufactures:				
Bars, rods, angles, shapes, sections --	r6,222	9,389	7,571	United States 1,796; People's Republic of China 899.
Universals, plates, sheets:				
Universals, plates, sheets, uncoated ----------	8,212	10,976	10,999	United States 1,702; People's Republic of China 1,562.
Tinned plates and sheets ----	865	785	908	United States 208; U.S.S.R. 76; Singapore 42.
Other coated plates and sheets --	1,465	r2,440	2,580	United States 1,114; Iran 162.
Hoop and strip ----------	563	967	1,006	Republic of Korea 35; U.S.S.R. 33.
Rails and accessories ----------	240	156	218	Brazil 36; United States 30.
Wire ----------	382	419	456	United States 160; Hong Kong 18.
Tubes, pipes, fittings ----------	4,541	5,192	5,206	U.S.S.R. 1,481; United States 1,090.
Castings and forgings, rough ------	15	28	30	United States 16; Canada 2.
Lead:				
Ore and concentrate ---------- tons	--	3,728	6,964	All to North Korea.

See footnotes at end of table.

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Table 2.—Japan: Exports of mineral commodities[1] —Continued

(Thousand metric tons unless otherwise specified)

Commodity	1975	1976	1977	Principal destinations, 1976
METALS —Continued				
Lead —Continued				
Oxide ____ tons	266	965	382	Vietnam 700; Taiwan 120.
Metal including alloys, all forms	42	r13	12	Republic of Korea 5; Taiwan 2; U.S.S.R. 2.
Magnesium metal including alloys, all forms ____ tons	r1,791	1,128	405	Netherlands 350; Australia 305.
Manganese:				
Ore and concentrate ____ do	3,976	6,128	5,206	Taiwan 1,280; Republic of Korea 1,132.
Oxide	23	34	24	United Kingdom 3; United States 3.
Mercury ____ 76-pound flasks	1,923	1,223	2,299	Republic of Korea 681; Netherlands 200.
Molybdenum metal including alloys, all forms ____ tons	16	18	43	Hungary 11; Republic of Korea 5.
Nickel:				
Ore and concentrate ____ do	r4	15	30	All to Sweden.
Metal including alloys, all forms ____ do	3,378	5,523	6,083	Netherlands 795; United States 621.
Phosphorus, elemental (red) ____ do	182	r186	98	United States 51; India 45; Taiwan 35.
Platinum-group metals and silver:				
Waste and sweepings ____ do	1	(3)	5	NA.
Metals including alloys:				
Platinum group thousand troy ounces	168	115	124	Taiwan 86; Hong Kong 9.
Silver ____ do	8,548	3,691	2,343	United States 2,126; Republic of Korea 485.
Selenium, elemental ____ tons	318	352	296	Netherlands 221; United States 51.
Tin:				
Oxide ____ do	17	29	3	Hong Kong 10; North Korea 8; Republic of Korea 6.
Metal including alloys, all forms ____ do	794	r707	941	Republic of Korea 215; Indonesia 97.
Titanium:				
Oxide	34	37	18	United States 23; United Kingdom 6.
Metal including alloys, all forms ____ tons	3,274	1,680	2,312	United States 1,258; Netherlands 140.
Tungsten metal including alloys, all forms ____ do	200	184	130	United States 50; Singapore 45; U.S.S.R. 33.
Zinc:				
Oxide ____ do	3,688	2,591	1,761	Taiwan 964; Vietnam 530; Cuba 328.
Metal including alloys, all forms	59	82	77	Republic of Korea 10; U.S.S.R. 10.
Other:				
Ores and concentrates:				
Of titanium, molybdenum, tantalum, vanadium, zirconium ____ tons	4,470	1,346	678	Taiwan 295; Republic of Korea 209; Spain 209.
Of base metals, n.e.s ____ do	--	(4)	5	NA.
Ash and residue containing nonferrous metals ____ tons	3,769	7,188	6,279	United States 2,604; Belgium-Luxembourg 1,326.
Oxides, hydroxides, peroxides of metals ____ do	2,067	1,373	1,361	United States 471; Republic of Korea 242.
Metals including alloys, all forms:				
Phosphorus and other metalloids ____ do	806	465	246	Taiwan 284; Republic of Korea 124.
Alkali, alkaline earth, rare earth metals ____ do	186	188	292	Taiwan 178; Republic of Korea 6.
Pyrophoric alloys ____ do	80	74	76	France 22; United States 13; Nepal 11.
Base metals including alloys, all forms, n.e.s ____ do	5,027	r6,406	5,982	United States 1,903; Netherlands 846.
NONMETALS				
Abrasives, natural, n.e.s.:				
Emery ____ do	701	919	1,134	Taiwan 597; Republic of Korea 235.
Natural abrasives, n.e.s ____ do	160	275	147	Taiwan 186; Brazil 60.

See footnotes at end of table.

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Table 2.—Japan: Exports of mineral commodities[1] —Continued

(Thousand metric tons unless otherwise specified)

Commodity	1975	1976	1977	Principal destinations, 1976
NONMETALS —Continued				
Abrasives, natural, n.e.s. —Continued				
Dust and powder of precious and semiprecious stones ____ thousand carats	769	33,339	1,111	West Germany 32,500; United States 734.
Grinding and polishing wheels and stones ____ tons	3,090	4,224	4,721	United States 599; Thailand 426.
Asbestos ____ do	2,158	3,529	1,226	Republic of Korea 2,334; Taiwan 1,134.
Barite and witherite ____ do	95	--	1,250	
Boron materials:				
Crude natural borates ____ do	507	60	17	All to Taiwan.
Oxide and acid ____ do	343	363	382	Vietnam 200; North Korea 60.
Cement ____	4,098	5,850	6,683	Kuwait 1,197; Singapore 1,119.
Chalk ____ tons	--	50	17	Philippines 30; Taiwan 17; United States 3.
Clays and clay products (including all refractory brick):				
Crude ____ do	30,455	37,433	53,360	Taiwan 18,703; Republic of Korea 6,225.
Products:				
Refractory ____ do	125,725	118,369	165,203	Republic of Korea 21,571; Brazil 10,613.
Nonrefractory[5] ____ do	52,445	44,571	55,410	United States 10,977; Australia 9,947.
Cryolite and chiolite ____ do	20	10	2	All to New Zealand.
Diamond:				
Gem, not set or strung ____ carats	3,200	1,664	798	Mainly to Hong Kong.
Industrial ____ thousand carats	4	(6)	1	Mainly to Republic of Korea.
Diatomite and other infusorial earth ____ tons	908	1,151	1,024	Taiwan 467; Australia 208; Poland 195.
Feldspar and fluorspar:				
Feldspar ____ do	4,495	9,512	11,224	Mainly to Taiwan.
Fluorspar, leucite, nepheline, nepheline syenite ____ do	343	1,050	840	New Zealand 505; Vietnam 400.
Fertilizer materials:				
Manufactured:				
Nitrogenous[7] ____	2,734	1,874	2,478	People's Republic of China 692; Brazil 215; Taiwan 122.
Phosphatic ____	9	18	23	Taiwan 9; Fiji 6.
Potassic ____	6	5	2	Indonesia 2; Philippines 2.
Other, including mixed ____	r125	80	43	Thailand 54; India 11.
Ammonia ____ tons	279,702	284,996	242,768	Philippines 259,817; Netherlands 7,873.
Graphite, natural ____ do	860	1,704	1,311	Taiwan 913; United States 450; Iran 122.
Gypsum and plasters ____ do	2,584	15,712	6,474	Taiwan 6,247; Indonesia 5,190.
Iodine ____ do	5,116	(8)	(8)	
Kyanite and related materials ____ do	8,592	10,165	16,496	Taiwan 7,725; Thailand 1,211.
Lime ____ do	31,364	34,312	29,287	Papua New Guinea 15,448; Kuwait 8,400.
Magnesite ____ do	324	405	5,299	Taiwan 150; Republic of Korea 140.
Mica ____ do	209	349	411	Hong Kong 132; Taiwan 122.
Pigments, mineral: Iron oxides, processed ____ do	5,746	12,141	12,554	United States 6,192; Taiwan 2,380.
Precious and semiprecious stones, except diamond:				
Natural ____ kilograms	84,207	240,899	135,208	Taiwan 143,725; Republic of Korea 50,131.
Manufactured ____ do	21,521	32,184	26,826	Republic of Korea 14,882; Netherlands 5,248.
Salt and brines ____ tons	1,858	1,059	958	Papua New Guinea 408; Republic of Korea 294.
Sodium and potassium compounds, n.e.s.:				
Caustic soda ____	365	211	164	Australia 185; Republic of Korea 14.
Caustic potash and sodic and potassic peroxides ____	5	5	5	Australia 2; Taiwan 1.
Stone, sand and gravel:				
Dimension stone ____ tons	330	1,095	332	Taiwan 337; Egypt 219.
Dolomite, chiefly refractory grade ____ do	7,284	6,909	6,340	Philippines 6,220; Taiwan 589.
Gravel and crushed rock ____ do	1,348	9,712	6,936	Australia 8,000; Taiwan 873.
Limestone (except dimension) ____	1,439	1,488	1,212	Mainly to Australia.
Quartz and quartzite ____ tons	219	133	478	Thailand 98; Taiwan 31.
Sand excluding metal bearing ____ do	1,134	1,899	1,813	Taiwan 824; Republic of Korea 339.

See footnotes at end of table.

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Table 2.—Japan: Exports of mineral commodities[1] —Continued

(Thousand metric tons unless otherwise specified)

Commodity	1975	1976	1977	Principal destinations, 1976
NONMETALS —Continued				
Sulfur:				
Elemental:				
Other than colloidal ---------tons--	117,267	335,660	467,929	Republic of Korea 232,117; Taiwan 64,482.
Colloidal ---------do----	831	457	519	Republic of Korea 248; Taiwan 163.
Sulfur dioxide ---------do----	108	55	20	Australia 33; Republic of Korea 13.
Sulfuric acid ----------	r60	r117	290	Philippines 57; Turkey 17; Spain 16.
Talc and steatite ---------tons--	454	1,499	1,721	Vietnam 500; Taiwan 253; Bangladesh 183.
Other:				
Crude ----------	7	10	9	Indonesia 5; Taiwan 2.
Slag, dross, and similar waste, not metal bearing ----------	37	r67	218	Republic of Korea 32; Singapore 17.
Oxides, hydroxides, and peroxides of magnesium, strontium, and barium (including clinker) ----------	168	125	145	Poland 18; Australia 13; France 12.
Fluorine and bromine ---------tons--	(6)	r 8 5,517	8 5,484	United States 2,775; United Kingdom 566.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural ---------do----	--	--	9	
Carbon black and gas carbon:				
Carbon black ----------	21	23	23	Taiwan 6; Thailand 5; Indonesia 2.
Gas carbon ---------tons--	--	r16	--	Singapore 9; Taiwan 7.
Coal, all grades, including briquets ----------	26	51	32	Republic of Korea 37; Taiwan 11.
Coke and semicoke ----------	733	540	530	Peru 126; Venezuela 95.
Gas, manufactured only ---------tons--	2	(9)	(9)	
Hydrogen and rare gases (helium, neon, krypton, xenon) ---------do----	r425	449	799	Iran 96; Republic of Korea 70; Taiwan 69.
Petroleum:				
Crude and partly refined thousand 42-gallon barrels--	4	(6)	(6)	All to United States.
Refinery products, nonbunker:				
Gasoline ---------do----	12	--	--	
Kerosine and jet fuel ---------do----	66	11	7	Mainly to Netherlands.
Distillate fuel oil ---------do----	47	129	5	Thailand 115; Republic of Korea 13.
Residual fuel oil ---------do----	8,415	3	72	Indonesia 2; Taiwan 1.
Lubricants ---------do----	r1,831	r1,273	2,066	Republic of Korea 528; Taiwan 190.
Other:				
Liquefied petroleum gas ---do----	92	54	40	Vietnam 31; Hong Kong 21.
Naphtha ---------do----	677	(6)	28	NA.
Mineral jelly and wax ---------do----	237	199	447	Republic of South Africa 35; Republic of Korea 31.
Bitumen ---------do----	136	184	39	Burma 119; Vietnam 55.
Unspecified ---------do----	r153	r117	170	Italy 40; Republic of Korea 35.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals ----------	r71	95	77	Republic of Korea 45; Taiwan 16.

rRevised. NA Not available.

[1]Excludes exports under the Japanese-United States Mutual Defense Agreement or for account of the U.S. military forces.

[2]Includes spiegeleisen, if any.

[3]Value only reported at $41,460.

[4]Value only reported at $24,124.

[5]Excludes mosaic tile valued as follows: 1975 - $53,628,026; 1976 - $71,600,536; 1977 - $82,726,943.

[6]Less than 1/2 unit.

[7]Includes exports of the following amounts of urea containing more than 45% N: 2,205,265 tons in 1975; 746,453 tons in 1976; and 1,047,585 tons in 1977.

[8]Iodine is inseparable from fluorine and bromine.

[9]Same as gas carbon.

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Table 3.—Japan: Imports of mineral commodities[1]

(Thousand metric tons unless otherwise specified)

Commodity	1975	1976	1977	Principal sources, 1976
METALS				
Aluminum:				
Bauxite and concentrate	4,600	4,277	5,318	Australia 2,717; Indonesia 967.
Oxide and hydroxide	561	r627	933	Mainly from Australia.
Fused aluminum (artificial corundum) tons	598	1,292	3,942	India 901; West Germany 166.
Metal including alloys:				
Scrap	29	69	70	United States 47; Canada 8.
Unwrought	378	430	534	New Zealand 105; U.S.S.R. 69; Bahrain 63.
Semimanufactures	22	21	23	United States 6; Romania 5.
Antimony:				
Ore and concentrate tons	9,012	12,703	7,501	Bolivia 8,444; People's Republic of China 819.
Metal including alloys, all forms do	r454	1,055	1,239	People's Republic of China 811; Bolivia 146.
Arsenic:				
Natural sulfides do	20	--	4	
Trioxide, pentoxide, acids do	906	r1,360	1,076	People's Republic of China 767; France 396.
Beryllium metal including alloys, all forms kilograms	1,922	3,835	6,098	All from United States.
Bismuth metal including alloys, all forms tons	(2)	--	--	
Cadmium metal including alloys, all forms kilograms	1	--	--	
Chromium:				
Ore and concentrate	1,269	1,217	900	Republic of South Africa 416; India 238.
Oxide and hydroxide tons	1,088	2,579	3,061	West Germany 904; United States 827.
Cobalt:				
Oxide and hydroxide do	252	754	597	Belgium-Luxembourg 689; United States 26.
Metal including alloys, all forms do	r1,582	3,931	2,083	Zaire 2,658; Zambia 482.
Columbium and tantalum:				
Columbium (niobium) ore and concentrate do	2,350	1,813	1,751	Brazil 611; Nigeria 484.
Tantalum:				
Ore and concentrate do	62	62	170	Mainly from Australia.
Metal including alloys, all forms do	21	50	47	Mainly from United States.
Copper:				
Ore and concentrate	2,605	2,587	2,823	Philippines 814; Canada 742.
Copper sulfate[3] tons	r243	155	376	Mainly from People's Republic of China.
Metal including alloys:				
Scrap	39	34	41	United States 16; Taiwan 7.
Unwrought	184	233	272	Zambia 113; Chile 43; Canada 15.
Semimanufactures tons	1,729	r1,455	r1,239	United States 864; West Germany 181.
Germanium:				
Dioxide do	4	9	8	U.S.S.R. 6; West Germany 2.
Metal including alloys, all forms kilograms	5	16	826	Italy 10; Belgium-Luxembourg 6.
Gold metal thousand troy ounces	--	2,364	1,661	Switzerland 1,499; United Kingdom 786.
Indium metal including alloys, all forms kilograms	4	4,672	1,262	Canada 1,385; Peru 1,255; U.S.S.R. 724.
Iron and steel:				
Ore and concentrate, except roasted pyrite	r131,657	133,727	132,571	Australia 64,094; Brazil 25,380.
Roasted pyrite tons	4,173	8,924	17,556	Mainly from Philippines.
Metal:				
Scrap	r3,081	1,802	1,440	United States 1,084; Australia 354.
Pig iron including cast iron	399	584	543	India 241; Australia 202.
Sponge iron, powder, shot	9	9	7	Mainly from Sweden.
Ferroalloys	90	179	191	Republic of South Africa 101; Taiwan 25.
Steel, primary forms	69	r112	160	Mainly from Australia.
Semimanufactures	41	r33	36	Republic of Korea 21; United States 4.

See footnotes at end of table.

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Table 3.—Japan: Imports of mineral commodities[1] —Continued

(Thousand metric tons unless otherwise specified)

Commodity	1975	1976	1977	Principal sources, 1976
METALS —Continued				
Lead:				
Ore and concentrate	201	155	194	Canada 80; Peru 35; United States 14.
Oxide tons	201	410	511	Bulgaria 327; United Kingdom 68.
Metal including alloys:				
Scrap do	1,103	1,402	2,856	United States 952; Bahrain 191.
Unwrought do	17,202	35,029	32,075	Mexico 11,736; North Korea 11,627.
Semimanufactures do	11	10	12	United States 8; West Germany 2.
Magnesium metal including alloys, all forms do	r2,781	r5,143	2,760	Norway 2,715; United States 2,242.
Manganese:				
Ore and concentrate[4]	r3,832	3,356	2,754	Republic of South Africa 1,266; Australia 804.
Oxide kilograms	24	2,139	685,323	United States 1,631; Belgium-Luxembourg 500.
Mercury 76-pound flasks	2,567	2,242	2,595	Algeria 1,101; Spain 941.
Molybdenum:				
Ore and concentrate tons	12,128	17,916	16,505	United States 9,247; Canada 7,168.
Trioxide do	90	482	498	United States 321; Netherlands 141.
Metal including alloys, all forms do	106	39	37	West Germany16; United States 15.
Nickel:				
Ore and concentrate	3,397	3,450	3,951	New Caledonia 2,635; Indonesia 812.
Metal including alloys:				
Scrap tons	1,535	4,737	3,883	United States 2,543; Taiwan 1,355.
Unwrought do	8,639	12,150	11,121	Republic of South Africa 3,038; U.S.S.R. 2,950.
Semimanufactures do	1,656	1,330	3,001	United Kingdom 536; Canada 346.
Matte, spiess, similar materials	27	45	41	Australia 28; Canada 13.
Platinum-group metals:				
Waste and sweepings value	$46,061	$212,460	$96,510	Republic of Korea $109,597; Hong Kong $102,863.
Metals including alloys, all forms:				
Platinum thousand troy ounces	1,563	r1,214	1,170	Republic of South Africa 558; U.S.S.R. 426.
Palladium troy ounces	441,948	609,473	497,708	U.S.S.R. 397,237; United Kingdom 136,929.
Rhodium do	45,038	28,135	26,492	U.S.S.R. 18,891; Republic of South Africa 8,678.
Iridium, osmium, ruthenium troy ounces	13,079	24,274	11,276	Republic of South Africa 16,684; United States 5,112.
Alloys do	29,581	36,342	37,241	West Germany 23,144; United States 8,286.
Rare-earth metals:				
Oxides and crude chlorides[5] tons	r990	r1,866	2,068	India 1,140; France 251.
Metals (yttrium, scandium, intermixtures) kilograms	1,452	2,753	48,467	United States 1,438; Brazil 1,000.
Selenium, elemental do	2,870	1,270	2,381	All from Canada.
Silicon tons	3,343	19,069	20,829	Republic of South Africa 4,359; Norway 3,084.
Silver:				
Waste and sweepings value	r$15,620	r$3,527	$34,415	All from Singapore.
Ore and concentrate tons	3,450	4,250	4,000	All from Republic of Korea.
Metal including alloys, all forms thousand troy ounces	17,053	20,533	17,923	Peru 9,762; Mexico 3,854.
Tellurium kilograms	2,518	11,978	3,000	U.S.S.R. 10,963; Netherlands 1,000.
Tin:				
Ore and concentrate tons	--	92	--	All from Australia.
Oxide do	13	6	7	Mainly from Australia.
Metal including alloys, all forms do	r22,050	r31,290	28,378	Malaysia 18,465; Indonesia 6,399.
Titanium:				
Ore and concentrate	444	497	496	Australia 203; Malaysia 124; India 64.

See footnotes at end of table.

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Table 3.—Japan: Imports of mineral commodities[1] —Continued

(Thousand metric tons unless otherwise specified)

Commodity	1975	1976	1977	Principal sources, 1976
METALS —Continued				
Titanium —Continued				
Slag	49	33	43	All from Canada.
Oxide tons	2,363	5,750	3,310	United Kingdom 1,461; France 1,355.
Tungsten:				
Ore and concentrate do	2,027	2,605	3,247	Republic of Korea 855; Thailand 540.
Metal including alloys, all forms do	22	92	97	Republic of Korea 84; France 5.
Uranium and thorium:				
Ores and concentrates do	30	100	84	All from Zaire.
Oxides (composed of thorium and uranium depleted in U-235) kilograms	3,521	6,959	580	United States 6,653; West Germany 156.
Metals including alloys, all forms do	4,440	647	565	West Germany 561; United States 86.
Vanadium pentoxide tons	2,876	3,225	2,052	Republic of South Africa 2,226; United States 635.
Zinc:				
Ore and concentrate	946	986	963	Peru 325; Canada 261; Australia 256.
Oxide tons	884	1,649	1,981	Taiwan 623; People's Republic of China 341; Republic of Korea 260.
Metal including alloys, all forms	22	29	29	Mainly from North Korea.
Zirconium ore and concentrate (including zircon sand) tons	85,389	112,925	68,040	Australia 109,170; India 2,032; Malaysia 1,098.
Other:				
Ores and concentrates of base metals do	114	30	10	All from Malaysia.
Ash and residue containing nonferrous metals tons	13,082	21,643	28,716	Australia 6,352; United States 4,172.
Oxides, hydroxides, pentoxides of metals, n.e.s. do	1,977	r1,454	1,700	United States 938; Canada 193; U.S.S.R. 129.
Metals including alloys, all forms:				
Metalloids[6] do	r5,891	r6,503	10,666	United States 4,614; U.S.S.R. 1,334.
Alkali and alkaline-earth metals do	29	63	45	U.S.S.R. 30; United States 30.
Pyrophoric alloys (ferrocerium) do	9	14	10	Australia 3; West Germany 3; United Kingdom 3.
Base metals including alloys, all forms, n.e.s do	770	1,099	1,059	Republic of South Africa 862; United States 124.
NONMETALS				
Abrasives, natural, except diamond, n.e.s.:				
Crude do	1,284	3,120	3,595	India 1,540; United States 1,287.
Dust and powder of precious and semiprecious stones kilograms	8,975	r17,422	11,985	West Germany 17,340; United States 82.
Grinding and polishing wheels and stones tons	524	r279	242	Taiwan 118; United States 80.
Asbestos	253	325	301	Canada 144; Republic of South Africa 97.
Barite and witherite	11	17	33	Thailand 11; People's Republic of China 6.
Boron materials:				
Crude natural borates	18	36	49	Turkey 31; U.S.S.R. 4.
Oxide and acid	14	15	16	United States 11; U.S.S.R. 2.
Cement	2	2	1	Mainly from United States.
Clays and clay products:				
Crude:				
Kaolin	284	374	404	United States 268; Republic of Korea 84.
Kyanite, andalusite, sillimanite	24	22	22	Republic of South Africa 12; United States 5.
Other	283	256	268	United States 95; Republic of Korea 70.
Products:				
Refractory (including nonclay brick) tons	9,099	8,323	4,664	United States 3,282; People's Republic of China 1,673.
Nonrefractory do	15,381	24,307	21,016	Republic of Korea 14,292; Italy 5,305.
Cryolite and chiolite do	149	257	246	Denmark 143; Greenland 114.
Diamond:				
Gem, not set or strung thousand carats	648	r719	749	Israel 257; India 167; Belgium-Luxembourg 123.

See footnotes at end of table.

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Table 3.—Japan: Imports of mineral commodities[1] —Continued

(Thousand metric tons unless otherwise specified)

Commodity	1975	1976	1977	Principal sources, 1976
NONMETALS —Continued				
Diamond —Continued				
Industrial stones ____ thousand carats	421	r636	736	United States 174; United Kingdom 140.
Powder and dust ____ do	7,485	r10,645	13,034	United States 5,605; Ireland 2,743.
Diatomite and other infusorial earth ____ tons	4,105	2,656	5,046	United States 2,534; North Korea 97.
Feldspar, leucite, nepheline, nepheline syenite ____ do	5,091	5,346	12,335	People's Republic of China 3,139; Republic of Korea 1,100.
Fertilizer materials:				
Crude:				
Nitrogenous (natural sodium nitrate) ____ tons	__	r475	__	All from Chile.
Phosphatic ____	2,904	2,335	2,652	United States 1,358; Morocco 443.
Manufactured:				
Nitrogenous ____	r5	r17	20	Chile 11; Republic of Korea 3; Netherlands 2.
Phosphatic ____	6	25	64	Mainly from United States.
Potassic ____	1,385	1,109	1,315	Canada 494; U.S.S.R. 201; United States 128.
Mixed ____	78	163	172	Mainly from United States.
Ammonia ____ tons	8	10	6	All from United States.
Fluorspar ____	363	383	373	Thailand 122; People's Republic of China 117.
Graphite, natural ____	58	34	65	Republic of Korea 16; North Korea 7; U.S.S.R. 5.
Gypsum and plasters ____	15	35	30	Morocco 29; Canada 6.
Magnesite and magnesia clinker ____	r67	r107	52	North Korea 93; People's Republic of China 9.
Mica, all forms ____	r6	9	9	India 4; Republic of Korea 3; Malaysia 1.
Pigments, mineral, including processed iron oxides ____ tons	2,370	3,170	2,852	West Germany 1,672; People's Republic of China 700.
Precious and semiprecious stones, except diamond:				
Natural ____ do	r1,668	r1,325	652	Brazil 983; India 80.
Manufactured ____ do	49	r629	24	Mainly from United States.
Pyrite, gross weight ____ do	55,887	59,403	34,060	All from Philippines.
Salt ____	r6,301	6,342	6,415	Australia 3,244; Mexico 2,597.
Sodium and potassium compounds, n.e.s.:				
Caustic soda ____ tons	2,354	716	47,440	Romania 500; Taiwan 137.
Caustic potash and sodic and potassic peroxides ____ do	(2)	55	127	United States 35; West Germany 20.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked ____	259	287	410	Republic of South Africa 82; India 59.
Worked ____	19	30	45	Republic of Korea 21; Italy 3; Taiwan 3.
Dolomite including agglomerated dolomite ____	93	199	229	Mainly from Republic of Korea.
Gravel and crushed rock ____	71	37	83	Taiwan 18; France 7; Republic of Korea 6.
Limestone ____ tons	249	937	595	All from France.
Quartz and quartzite ____	166	139	171	Republic of Korea 99; Thailand 18; India 7.
Sand excluding metal bearing ____	428	432	485	Australia 398; Taiwan 20; Republic of Korea 12.
Sulfur:				
Elemental colloidal ____ tons	296	603	781	Mainly from United States.
Sulfuric acid ____ do	14	19	5	Mainly from West Germany.
Talc, steatite, soapstone, pyrophyllite ____	236	302	361	People's Republic of China 166; Republic of Korea 50.
Other:				
Crude:				
Meerschaum, amber, jet ____ kilograms	40	153	2,127	U.S.S.R. 150; Poland 3.
Unspecified ____	228	254	313	Republic of Korea 154; Philippines 33.
Slag, dross, and similar waste, including kelp, not metal bearing ____	r213	82	146	India 37; Republic of Korea 34.
Oxides, hydroxides and peroxides of magnesium, strontium, barium ____ tons	122	158	308	West Germany 89; United States 68.

See footnotes at end of table.

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Table 3.—Japan: Imports of mineral commodities[1] —Continued

(Thousand metric tons unless otherwise specified)

Commodity	1975	1976	1977	Principal sources, 1976
NONMETALS —Continued				
Other —Continued				
Bromine and iodine ____ tons	7	208	708	All from Israel.
Fluorine ____ kilograms	97	(2)	--	All from United States.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural ____ tons	2,253	3,228	8,580	United States 3,206; Trinidad and Tobago 22.
Carbon black ____	4	7	7	United States 4; U.S.S.R. 2.
Coal and briquets:				
Anthracite ____	1,026	1,072	1,489	Vietnam 565; People's Republic of China 200.
Bituminous:				
Heavy coking coal, less than 8% ash ____	14,939	r18,060	17,814	United States 10,923; Australia 3,327.
Heavy coking coal, more than 8% ash ____	33,030	28,211	27,236	Australia 14,777; Canada 8,608.
Other coking coal ____	13,112	13,416	14,301	Australia 8,185; United States 3,579.
Lignite and lignite briquets ____	11	12	42	All from Australia.
Coke and semicoke ____	r192	151	204	Australia 79; United States 67.
Gas, hydrocarbon (liquefied natural gas) thousand 42-gallon barrels	52,894	67,185	84,211	Brunei 56,097; United States 11,088.
Hydrogen, helium, rare gases ____ kilograms	95,172	r104,293	123,734	Mainly from United States.
Peat, including peat briquets and litter ____ tons	3,226	7,795	6,198	U.S.S.R. 3,087; Canada 2,620; Poland 1,467.
Petroleum:				
Crude and partly refined:				
Crude ____ thousand 42-gallon barrels	1,600,129	1,598,567	1,666,878	Saudi Arabia 507,803; Iran 339,695.
Partly refined ____ do.	56,437	--	--	
Refinery products:				
Gasoline ____ do.	741	r51,424	r52,242	Singapore 14,636; Saudi Arabia 12,199.
Kerosine and jet fuel ____ do.	2,434	r2,704	2,861	Singapore 2,435; United States 141.
Distillate fuel oil ____ do.	23,106	r102,277	95,231	Saudi Arabia 67,721; Kuwait 14,654.
Residual fuel oil ____ do.	r30,477	r73,492	75,587	Indonesia 26,060; Kuwait 15,269.
Lubricants ____ do.	r897	r744	877	United States 435; Singapore 126.
Other:				
Liquefied petroleum gas ____ do.	65,923	r775	125	Australia 554; Iran 118; Saudi Arabia 93.
Naphtha ____ do.	r31,779	(8)	(8)	
Paraffin ____ do.	80	r44	27	United States 28; People's Republic of China 13.
Petroleum coke thousand 42-gallon barrels	11,657	10,114	10,171	United States 8,810; People's Republic of China 578.
Unspecified ____ do.	r395	r95	65	United States 48; West Germany 33.
Total ____ do.	r167,489	r241,669	237,186	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals ____	83	116	137	Republic of Korea 71; United States 16.

r Revised.
[1] Excludes imports under the Japanese-United States Mutual Defense Agreement or for account of the U.S. Military forces.
[2] Less than 1/2 unit.
[3] Includes zinc sulfate.
[4] Includes ferruginous manganese and manganese dioxide.
[5] Includes cerium fluoride and lanthanum nitrate.
[6] Includes phosphorous, lithium, boron and arsenic.
[7] Includes all petroleum spirits.
[8] Included under "gasoline."

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COMMODITY REVIEW

METALS[7 8]

Aluminum.—Japan, with an annual production capacity of 1.6 million tons, is the world's third largest producer of aluminum metal after the United States and the U.S.S.R. However, because of the increasing cost of energy, Japan's industry lost international competitiveness following the energy crisis of 1973. About 15,000 kilowatts of electrical energy is needed to produce one ton of ingot. Domestic electricity costs between Y9 and Y10 per kilowatt compared with overseas prices of Y1 to Y5. Additionally, because of the yen appreciation, the price of foreign ingot was around Y300,000 per ton compared with the Japanese producer price of Y371,000. In 1977, producers were operating at 74% of capacity, and each company was estimated to have a Y5 billion deficit. In its report, the Industrial Structure Council recommended that about 24% of the present capacity be frozen or partly scrapped during 1978-82 and holding production to 1.2 million tons in 1978; covering the difference in domestic production and demand for ingot by imported metal; a joint sales company be created to reduce competition between producers; and a tariff quota system for imported metal be introduced to raise revenue for subsidizing interest payments in frozen capacity.

Because of the economic problems associated with domestic aluminum production, the industry turned to overseas ventures. Construction began in July 1977 on a joint Japanese and Indonesian project to develop hydroelectric power and an aluminum smelter in the Asahan River area in northern Sumatra. Completion of first-stage construction was planned for 1986; however, completion may be delayed because of rapidly increasing financial outlays. In late 1977, Nippon Amazon Aluminum Co. (Tokyo) and Brazilian investors reached an agreement to set up a joint venture involving an alumina-aluminum complex in Belem at the mouth of the Amazon River. In another venture, Japanese and Venezuelan investors reached an agreement for a smelter with a production capacity of 280,000 tons of metal a year. The terms included that 160,000 tons of ingot was to be shipped to Japan starting in March 1978.

Total imports by Japan of bauxite were 5.3 million tons in 1977, compared with 4.3 million tons in 1976. Australia continued to be the principal supplier of bauxite for Japan's aluminum industry. In 1977, shipments of bauxite from Australia totaled nearly 3.5 million tons. About 1.2 million tons of bauxite was imported from Indonesia and about 520,000 tons was supplied by Malaysia. The remainder of the bauxite shipments and imports of alumina were from Guyana, Surinam, China, Greece, Trinidad, the United States, India, Brazil, and Guinea, in that order.

Imports of unwrought aluminum metal valued at Y110.9 billion in 1977 totaled 411,624 tons and were principally from New Zealand, Bahrain, Canada, Australia, and the U.S.S.R; imports of unwrought aluminum valued at Y31.2 billion were 126,657 tons, of which almost 50% were supplied by the U.S.S.R. Receipts of aluminum waste and scrap valued at Y16.1 billion during the year totaled 70,470 tons, of which 43,348 was from the United States.

Production of alumina by four companies in 1977 was 1.8 million tons, up 26% from the output in 1976. Alumina production was by Nippon Light Metal Co., Ltd., Showa Keikinzoku K.K., Sumitomo Aluminum Refining Co., and Mitsui Aluminum Industry Co. Production of primary aluminum metal by 14 smelters of 6 companies was 1.2 million tons in 1977, up 3% from that of 1976. Because of high inventories, the industry operated at 73.9% of capacity during the year compared with 61.6% in the previous year.

Production of super-purity aluminum metal was 4,700 tons in 1977, up 9% from the output in 1976. Production was by the Kambara smelter of Nippon Light Metal and the Kikumoto smelter of Sumitomo Aluminum.

Copper.—Copper is one of the important mineral resources of Japan, and mine output averages around 80,000 tons per year. Mine production was from 10 mines—7 in Akita prefecture (Hanaoka, Kosaka, Shakanai, Matsuki, Fukazawa, Osarezawa, and Minami-Furutobe) and 1 each in Hakkaido prefecture (Shimokawa mine), Iwate (Kamaishi), Hyogo (Akenobe), and Ibaragi (Hitachi). Late in 1977, Mitsubishi Metal Corp. announced the closure of the Osarusawa mine and the Matsuki mine in January 1978. The Osarusawa mine had

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been operated for nearly 1,270 years, producing 70,000 tons of ore per month at the height of the operation in the 1950's. Current output level has been around 17,000 tons of ore per month, employing 220 persons. The Matsuki mine employs 160 workers and produces about 13,000 tons of ore per month. The company cited high operating costs, exhausted ore deposits, and weak formation as factors for the shutdowns.

Dowa Mining Co. was expected to invest Y3 billion in developing Ezuri mine, which contained 3 million tons of black ore grading 10.1% zinc, 3.32% lead, 0.89% copper, and 180 grams of silver and 1.3 grams of gold per ton of ore. Initial operation was scheduled for October 1979 with production of ore at 10,000 tons per month, to be raised to 18,000 tons the following year. To supplement domestic requirements, Japan imported 2.8 million tons of ore and concentrates valued at Y239.8 billion. Principal suppliers were Canada (855,895 tons), the Philippines (804,349), Papua New Guinea (362,231 tons), China (210,693), Indonesia (157,905 tons), Zaire (130,144 tons), Australia (127,233 tons), and Sabah (115,489 tons).

During the year, refined metal production totaled 934,000 tons and imports of unwrought metal totaled 272,000 tons, together valued at Y100.7 billion. Shipments in 1977 by major producers were as follows, in tons, with values in billion yen in parentheses: Nippon Mining, 229,344 (79.8); Mitsubishi Metal, 218,457 (78.9); Mitsui Mining and Smelting, 123,064 (39.3); Sumitomo Mining, 137,849 (46.9); Dowa Mining, 120,293 (40.9); Furukawa Mining, 74,880 (25.1); and Toho Zinc, 3,339 (1.2).

Producers continued to be plagued with sluggish demand, price reductions, deteriorating profits, and swelling inventories. Under the Nonferrous Stockpile Program, 20,000 tons of copper metal was purchased to help ease the supply-demand imbalance. In May 1977, copper inventories increased to 160,000 tons, and in December, the price for copper reached a low of Y320,000 per ton. In August, Mitsui Mining and Smelting and other smelters were successful in postponing the development of the Michiquillay copper mine in Peru. Also, Cobre Panama S.A. (Mitsui Mining, Mitsubishi Metal, and Dowa Mining) delayed exploration during the year of copper deposits at Petaquillay, and Dowa Mining sold its interest in the Chacarilla copper deposits in Bolivia to local investors. In addition, Japanese developers were involved with mining in Kinsenda and Musoshi, Zaire, and in Manut, Malaysia. The African operations were reportedly having financial difficulties, and the Malaysia venture was suffering from technical problems.

Iron and Steel.—Japan has the third largest iron and steel industry in the world, following the U.S.S.R. and the United States. More significantly, the country's production facilities are large, integrated, efficient, and modern. During December 1977, Tokyo Seitetsu closed down the last open-hearth furnaces in Japan. The Okayama Works had been operating five 120-ton open hearths, which were replaced by electric furnaces. Since the beginning of the decade, investments for plant and equipment by the steel industry averaged Y863.4 billion annually. Investments in 1977 totaled Y731.9 billion, which included Y82.7 billion for antipollution facilities.

Japan's industry has 100 basic oxygen furnaces (BOF's) with a collective annual capacity of 140.62 million tons, compared with 79 BOFs for the United States (80.07 tons per year), 45 for the U.S.S.R. (43.6 tons per year), and 36 for the Federal Republic of Germany (43.55 tons per year). There are 38 blast furnaces, each with a volume of more than 2,000 cubic meters. At yearend 1977, there were 684 electric furnaces, 130 continuous casting machines (34 for slab and 96 for bloom and billet), 23 hot-strip mills, and 70 cold-strip mills.

The industry is widespread throughout the country, but the highest concentration of main steelworks in Japan are in Kinki (18), Kanto (15), Chugoku (11), Chubu (9), Tohoku (5), Hokuriku and Kyushu (4 each), and Hokkaido and Shikoku (2 each). Japan's steel production of 102.4 million tons in 1977 was 5% less than that of 1976, and well below the peak production of 119.3 million tons in 1973. Japan trailed the U.S.S.R. and the United States with crude steel production of 146.7 million tons and 113.7 million tons, respectively, in 1977. Japan, however, continued to be the world's foremost exporter of steel with about 35.0 million tons in 1977, a decrease of 5.5% from shipments in 1976.

Five Japanese steel companies, headed by Nippon Steel Corp., were among the world's top 15 producers in 1977, with output of 32.4 million tons. The other top producers were as follows, in million tons: United States Steel, 26.1; British Steel, 17.2; Bethlehem

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Steel, 15.1; Nippon Kokan, 13.8; FINSIDER, 12.9; Sumitomo, 12.5; Kawasaki, 12.5; August Thyssen, 11.5; National Steel, 8.5; Republic Steel, 8.4; Kobe, 7.4; Broken Hill, 7.3; and Inland Steel, 7.0.

Domestic mine output of iron sands, pyrite sinter, and iron ore concentrates constitutes about 1% of the total industry requirements. Nittetsu Kogyo announced it would close the Kamaishi mine, the only iron ore mine in Japan, in 1979 because of financial difficulties. During the year, 132,571,000 tons of iron ore was imported, primarily from Australia (47.6%), Brazil (17.9%), and India (13.5%). Japan's largest iron ore suppliers continued to be mainly Hammersley Iron Pty., Ltd., Mount Newman Iron Ore Co., Mount Goldworthy Mining Ltd., Robe River Mines, Ltd., and Broken Hill Pty., Ltd., of Australia; Rio Doce and Mineracoes Brasileiras Reunidas of Brazil; and the Mineral and Metal Trading Corp. of India.

Japan imported 1.5 million tons of ferruginous manganese ore, 1.5 million tons of manganese ore, 0.6 million tons of pig iron, and 1.4 million tons of iron and steel scrap, and 55.9 million tons of coking coal. Most of the coking coal was provided by Australia (44%), the United States (26.9%), and Canada (18.5%). About 130.9 million tons of iron ore was consumed for ironmaking. In 1977, consumption by the iron and steel producers included 84.2 million tons of pig iron, 34.6 million tons of iron and steel scrap, 43.8 million tons of coke, 62.7 million tons of coking coal, 7.9 million kiloliters of heavy fuel oil, 5.1 billion cubic meters of oxygen, 64.6 billion kilowatt-hours of electricity, 1.4 million tons of manganese ore, and 17.9 million tons of limestone.

During the year, crude steel production totaled 102.4 million tons. A breakdown of steel production, by type of furnace, was as follows, in million tons: Basic oxygen, 82.4; electric, 20.0; and open hearth, 0.4. About 98% of the total output was consumed for rolled products and the remainder for forgings and castings. Production of hot-rolled ordinary steel totaled 79.6 million tons and for hot-rolled special steel, 10.3 million tons. Production of ferroalloys in 1977 was 1.6 million tons.

Steel exports in 1977 were estimated at 34.9 million tons valued at $10.9 billion. Compared with 1976, the volume of exports decreased 5.5% but value increased 0.9%. The average export price per ton in 1977 was $312, compared with $294 in 1976 and $348 in 1975. Exports of ordinary steel products were 30.6 million tons; shipments of special steel products were 1.8 million tons.

Shipments totaling 12.9 million tons went to Southeast Asia, the largest market for Japan's steel industry. Exports to China increased by 29% to 4.5 million tons in 1977. Shipments to Taiwan and South Korea were 1.4 million tons and 1.9 million tons, respectively. Demand for Japanese steel products in the Middle East weakened, and exports to this area decreased 25% to 3.9 million tons. Exports to Europe were 4.7 million tons, including 1.3 million tons shipped to the U.S.S.R. Japanese steel exports to the United States totaled 7.6 million tons during the year.

Lead and Zinc.— Domestic mine production supplied about one-fourth of the total industry smelter output of lead and zinc. The major lead-zinc mines in Japan were Kamioko (Iwate Prefecture), Hanaoka (Akita), Hosokura (Miyagi), Kosaka (Akita), Nakatatsu (Fukui), Toyoha (Hokkaido), Osarizawa (Akita), Akenobe (Hyogo), Shakanai (Akita), Furutube (Akita), and Oppu (Aomori).

The Metal Mining Agency of Japan conducted core drilling totaling 14,628.8 meters on eight projects in its domestic exploration and development program. As a result of its geological survey, the agency discovered a mineralized zone of Kuroko (black) ore in the Hokuroku area, a zinc-rich mineralized zone in the Nakatatsu area, and lead-zinc veins in the Bantan area. Private companies have been conducting exploration for Kuroko ore as well, particularly in the Hokuroku and Iwami areas. New zinc deposits were discovered at the Kamioka and Nakatatsu mines, and a high-grade, vein-type deposit at the Toyola mine was found in Hokkaido. Dowa Mining began developing the Ezuri mine, which contains about 10% zinc in Kuroko ore. Toho Zinc, however, suspended its plan to develop a lead-zinc mine in Guatemala.

Because of the yen revaluation and the low prices for lead and zinc, domestic mining operations were forced to lay off workers during 1977. The major producers of lead and zinc in Japan were Mitsui Mining & Smelting Co., Ltd., Toho Zinc Co., Ltd., Nippong Mining Co., Ltd., Mitsubishi Metal Corp., the Dowa Mining Co., Ltd., and Sumitomo Metal Mining, in that order. Mitsui Mining suffered the largest deficit in its

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operations, amounting to Y4,593 million, because of low zinc prices. Toho Zinc had a deficit of Y2,750 million, followed by Sumitomo Metal with Y2,181 million and Dowa Mining with Y1,185 million. Nippon Mining had a net profit of Y3,109 because of its oil operations and the higher yen value to the dollar. Mitsubishi Metal's net profit of Y1,481 million was the result of sales of bonds, securities, and real estate. Since 1974, annual zinc production has exceeded sales, and in 1978, sales of zinc ingot were expected to drop 2.2% to 765,000 tons. The price for zinc fell by about Y30,000 to Y174,000 per ton in December, chiefly from markdowns by foreign zinc ore suppliers and the rising yen value. Inventories of zinc reached a peak of 210,000 tons in May 1977.

Despite the severity of the economic conditions, primary zinc production increased 5% in 1977. During the year, production of electrolytic zinc totaled 472,233 tons; that of high-purity zinc, 130,293 tons; and that of distilled metal, 175,880 tons.

During the year, Mitsui Mining was completing improvments at Kamioka and Takehara. Hachinohe Smelter was installing a power plant that will utilize waste gas from its facility, and Akita Smelting was testing a decadmium purification process at its Iijima smelter.

Magnesium.—Production of magnesium metal in 1977 was by Furukawa Magnesium Co., Ltd., and Ube Kosan, Ltd. Total industry production capacity was 12,500 tons per year (Furukawa, 7,000 tons and Ube, 5,500 tons). Both producers use the Pidgeon process, utilizing domestic dolomite for metal production. Recovery of secondary metal during the year was about 7,600 tons, equivalent to about 80% of primary metal output.

Domestic consumption of magnesium averaged about 1,800 tons per month, and the shortfall between supply and demand is met by imported metal. Imported metal prices range between Y530,000 and Y540,000 per ton, compared with domestic producers' price of Y570,000 per ton. Should demand for can stock rise, a sharp increase in magnesium imports could adversely affect the small Japanese producers.

Manganese.—In 1977, domestic output of manganese ore from 17 mines was about 126,000 tons containing about 32,800 tons of manganese metal. Most of Japan's requirement for manganese, however, was met by imports supplied mainly by Australia, the Republic of South Africa, and Mexico. Approximately 97% of the manganese is used in the iron and steel industry. The remainder is consumed in battery manufacture, chemicals, and miscellaneous uses.

Production of electrolytic manganese during the year totaled 7,267 tons, compared with oxide production of 28,549 tons. Metal output was by Tekkosha Co., Ltd., and Chuo Denki Kogyo K.K., with a combined annual capacity of 14,000 tons. Production of manganese oxide was by Mitsui Mining & Smelting and Daiichi Carbon. Production of ferromanganese and silicomanganese by the iron and steel industry was 527,400 tons and 333,700 tons, respectively.

The price of domestically produced manganese metal is Y450,000 per ton. The base cost for imported metal was Y270,000 to Y280,000 per ton, excluding Y35,000 to Y36,000 for freight duty of 8% and trading charges. Total price of imported metal per ton was about Y100,000 less than the cost of domestic manganese.

MITI was planning to form a committee in 1978 to study exploitation of deep sea manganese nodules. Appointments to the committee were to be made from steel companies, refining companies, academia, and from government organizations.

Molybdenum.—Domestic production of molybdenum by two small mines remained nominal. Imports of molybdenum ore during the year were from the United States, the Federal Republic of Germany, South Korea, and Chile; in that order. Receipts of molybdenum concentrates were 16,505 tons.

The bulk of molybdenum was consumed in the production of molybdic oxide and ferromolybdenum. During the year, the iron and steel industry produced 3,705 tons of ferromolybdenum. Production of high-purity molybdenum metal totaled 275 tons.

Molybdenum is used in the production of high-tensile-strength steels, output of which fell 12% in 1977. Demand for molybdenum was expected to increase as a result of overseas sales of steels for large-diameter pipes to the Soviet Union and other countries.

Nickel.—For lack of indigenous resources, Japan imported all of its nickel needs. Metal production was by Sumitomo Metals and Mining, Shimura Kako, and Nippon Mining. Consumption of nickel was estimated at 19,700 tons, distributed as follows: Plating, 32%; special steels, 14%; cast steel alloys and electronics, each 10%;

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copper and coinage, each 4%; and other uses, 16%.

In terms of contained nickel, the quantity of ferronickel consumed was more important than nickel metal consumption. Pacific Metals Co., Ltd., Japan Metallurgical Industries, Nippon Mining Co., Sumitomo Metal Mining Co., and Shimura Kako Co., Ltd., were the five companies that produced ferronickel. As in the past, most of the ferronickel was consumed (56,982 tons) in the production of specialty steel and the remainder (17 tons) was used for cast steel.

Shimura Kako reached an agreement with its labor union in 1976 to transfer its nickel division from Tokyo to Date, Hokkaido. Preparation for construction of the nickel refinery at Date began in June 1977. The refinery was to be constructed adjacent to the company's existing ferronickel plant and was to have an annual production capacity of 10,000 tons of electrolytic nickel and 1,000 tons (nickel content basis) of nickel sulfate. The new plant, expected to be completed in April 1978, will utilize Inco's newly developed electrowinning process and replace the 7,200-ton-per-year nickel refinery in Tokyo. Total cost of construction was expected to be over Y10 billion.

Titanium.—Production of titanium sponge in 1977 by Osaka Titanium Co., Ltd., and Toho Titanium Co., Ltd., totaled 6,395 tons. The two companies have a combined rated output capacity of 950 tons per month, indicating that total production during the year was only 56% of total capacity. Titanium metal is used primarily for its corrosion-resistant properties. While consumption of titanium was on the upturn during 1972-74, demand slackened in 1975 and 1976 due to protracted orders for equipment for desalination, petrochemical, and caustic soda plants as a result of the prolonged recession.

In 1977, shipments of titanium ore and concentrates to Japan totaled 495,967 tons. Major suppliers were Australia (150,289 tons), Malaysia (130,024 tons), India (82,277 tons), Sri Lanka (41,219 tons), and Canada (92,104 tons). Only a small portion of the imports was used for metal production. Japan, on the other hand, is a prominent world producer of titanium dioxide (titania), using imported ilmenite as a raw material. Some rutile and anatase is also imported.

Tungsten.—Domestic production of tungsten concentrate in 1977 totaled 975 tons and was produced by Kaneuchi Mining (Kaneuchi and Fujigawa), Nittetsu Mining Co., Ltd. (Yaguki), Awamura Mining (Otani), Tanaka Mining (Kuga), Nittetsu Mining (Yaguki), Chitose Mining (Takatori), Mitsubishi Metal (Ikuno), and Chugai Mining Co., Ltd. (Tsumo). The largest production was by Kaneuchi Mining (393 tons), followed by Nittetsu Mining (300 tons) and Awamura Mining (170 tons). Imports of tungsten ore totaled 3,247 tons. The largest suppliers were South Korea (948 tons), Thailand (480 tons), Peru (414 tons), and Australia (399 tons). The remainder of tungsten imports were from Canada, China, Portugal, Zaire, Mexico, and Bolivia.

Demand for tungsten in 1977 was estimated at 3,821 tons, distributed as follows, in tons: Ferrotungsten, 520; synthetic scheelite, 751; tungsten metal, 2,544; inorganic chemicals, 4; and other, 1.

Other Metals.—Japan produced only a small quantity of antimony ore; virtually all antimony requirements are met by imports of ores and concentrates and metal. Output of metal in 1977 was by Hibino Metal Industries, by Nippon Mining and Concentrating, and by Mikuni Refining. Production of antimony oxide was by Nippon Mining and Concentrating, Sumitomo Metals & Mining, Hibino Metal industries, Mikuni Refining, and Japan Mining, in that order.

Production of bismuth metal, a byproduct of lead refining, was 698 tons in 1977. The largest producers were Mitsui Metals and Mining, Dowa Mining, and Sumitomo Metals & Mining, in that order. Domestic consumption of bismuth was estimated at 350 tons of which the largest use was as a metallurgical additive, followed by condensers, low fusing alloys, catalysts, and other.

Japan and the United States are the world's two leading producers of cadmium, a byproduct of zinc smelting. The uses for cadmium were in batteries, pigments, and as a stabilizer for polyvinyl chloride. Production of cobalt metal, a byproduct of copper and nickel refining, totaled 1,093 tons in 1977 compared with 515 tons in 1976. Most of Japan's requirement for cobalt is met by imports.

The estimated consumption for cobalt in 1977 was 2,455 tons compared with 2,996 tons in 1976. About 45% of the total use of cobalt in 1977 was for the production of permanent magnets for small speakers used in radios and television sets. The remainder of cobalt consumption was distributed as

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follows, in tons: Steel alloys, 557; ultrahard alloys, 112; catalysts, 107; and other uses, 562.

Japan is the world's largest producer of selenium. Selenium as well as tellurium was recovered as a byproduct in the processing of slimes generated from electrolytic copper refining. The major uses for selenium were in electronics and photocopier components, glass manufacture, chemicals, and pigments. A growing use for selenium was as an additive to stainless steel to improve machinability.

Japan is a major producer of indium, and output in 1977 was estimated at 8.0 tons, including recovery from recycled indium products. Toho Zinc was the largest producer with an annual production of 3.8 tons. Nippon Mining had an average monthly output of 250 kilograms, with a peak capacity of 280 kilograms. Dowa Mining began recovering indium in June 1976 from slag generated by gallium processing. Dowa Mining was capable of producing 50 kilograms per month. Tamaka Electronics Industries, an associated company of Mitsui Metals & Mining, has a monthly capacity of 50 kilograms of indium. Indium was used in electronic components and solders and other alloys.

During 1977, Japan produced 1.3 million troy ounces of gold and 38.2 million troy ounces of silver. Output of gold was derived mainly from the smelting of imported nonferrous ores. Recovery of silver was at a slightly higher level than in 1973-76; about one-third was from domestic ores. Domestic production of platinum and palladium was nominal, less than 1,000 kilograms, and Japan has had to import these noble metals in one form or another.

Japan also produced other metals, usually of high purity and generally in quantities significant by world standards. Refined metals and compounds produced, mostly from imported materials, included chromium, germanium, rare-earth metals, silicon, tantalum, and uranium.

NONMETALS[9]

Cement.—Japan ranks with the United States and the U.S.S.R. as one of the foremost producers of cement in the world. Total industry capacity to produce cement was 110 million tons per year. However, total output of cement during the year was only 62% of rated capacity. Production of cement was by 22 companies. Kyushu District had 19 plants, Kanto Shinetsu had 14, Kinki had 8, Chugoku had 7, Tohoku and Tokai-Hokuriku had 3, Hokkaido and Shikoku each had 2, and Okinawa had 1.

The top two producing companies were Onoda Cement Co. and Nihon Cement Co., which together accounted about 17% of total sales. Other top producers were Mitsubishi Mining & Cement Co., Sumitomo Cement Co., and the Industries, Ltd. Other large companies include Chichibu Cement Co., Osaka Cement Co., Tokuyama Soda Co., Toyo Soda Mfg. Co., and Denki Kagaku Kogyo Co.

In November 1975, cement manufacturers formed a production cartel to provide temporary relief to the industry, which suffered from slackened demand resulting from curtailment in construction projects since 1974. In 1976, 20 producers were member companies of the Cement Association of Japan. By binding together, the manufacturers of cement could attempt to mollify competition, make adjustments in production levels, and negotiate higher prices for cement. Production in 1976 was pushed back to the 1972 level and a similar cutback was effected for June-December 1977. Domestic sales in 1977 totaled 69.5 million tons. To cover the domestic slump, the industry pushed for overseas trade, and exports chiefly to Southeast Asia and the Middle East reached about 6.7 million tons. Total sales in 1977 of concrete aggregate were about 76 million tons.

To cope with soaring energy costs, producers halted operation of wet kilns in favor of dry kilns which use less fuel; conducted research and development on new suspension preheaters for energy savings as well as for pollution control; and branched out into other industrial lines, such as lightweight aggregate, ground preparation, and inorganic construction materials.

Fertilizer Materials.—Japan's chemical fertilizer industry is one of the largest in the world. In terms of nitrogen fertilizers, Japan ranks fourth in world production after the United States, the U.S.S.R., and China. The industry's output of calcium and phosphatic fertilizers was large, while that of potassic fertilizers was relatively insignificant. Japan's production of fertilizer materials also included large tonnages of ammonia; ammonium sulfate and chloride; calcium carbide, cyanamide, superphosphate; and fused magnesium phosphate. Japan's fertilizer industry has been traditionally

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export oriented, exporting 70% of the urea and ammonium chloride production and most of the ammonium sulfate production to Southeast Asia, China, and Latin America.

Japan's fertilizer industry has been adversely affected by low plant operation rates, international competitiveness, narrowing export markets, and increased costs. Since 1975, there has been a marked deterioration in profits, especially for nitrogen fertilizers. Although the foreign market prices for ammonium sulfate and urea were on an upward trend, the Japanese export prices were still insufficient to cover the added cost of energy and other raw materials for production. Significantly, the price of naphtha, the feedstock most widely used for urea production, rose nearly fivefold after the 1973 oil crisis. To worsen the situation, Japanese exports of fertilizers have sharply decreased during 1975-77.

In an attempt to remedy the bleak picture, the industry began planning to reshape its structure, exploit new markets, revamp its distribution system, and retire surplus or outmoded production equipment. The Japan Urea and Ammonium Sulphate Industry Association recommended at year-end 1977 reduction of total industry capacity—20% for ammonia and 40% for urea. Also, the Japan Phosphatic and Compound Fertilizer Manufacturers' Association recommended a 20% reduction in phosphoric acid capacity. MITI was forming a chemical fertilizer committee at the Industrial Structure Council to consider plans for scrapping or freezing industrial facilities.

Magnesium Compounds.—Japan's capacity to produce magnesium oxide from seawater was estimated at 750,000 tons per year. The largest producer was Ube Chemical Industries, which had about 58% of the total output capacity, followed by Shin-Nihon Chemical Industries Co., Hokuriku Seien Kogyo K. K., and Nihon Kasui Kako Co. Imports of magnesite and magnesia clinker during the year were 5,567 tons and 46,096 tons, respectively. By far the largest use for magnesia was in the production of basic refractories for heat insulating bricks for lining metallurgical furnaces, of which the largest consumption was in the iron and steel industry. The remainder of the magnesia consumption, about 10%, was in agricultural and chemical processing applications.

Salt.—Japan's salt production, all from evaporites, was 1,056,000 tons in 1977, compared with imports of 6,415,320 tons. The largest shipments were from Australia and Mexico. The remainder was from China and Canada. In 1975 both Australia and Mexico renegotiated price increases for salt exports to Japan. The producers claimed that higher prices were needed to make a reasonable profit. The average unit value of imports in 1977 from Australia was about $18.08 per ton, compared with $16.15 per ton from Mexico.

Aside from human consumption, salt is needed in Japan mainly by the chlor alkali industry. Throughout 1977, the chlor alkali industry consisting of 36 firms with 54 plants operated at around 60% of capacity to produce 2.7 million tons. The industry was faced with depressed demand for caustic soda in 1977, as well as with the Government decree for the industry to switch production technology from mercury cells to a nonmercury technique by March 1978. Most producers chose the asbestos diaphragm technique. The change in technology was expected to cost between Y600 and Y800 billion. In addition to declining profits and the prospect of large capital outlays to change technology, the industry faced technical problems in the switchover.

Because of depressed demand, low prices (Y54,000 per ton in 1977 compared with Y53,000 per ton in 1976), and yen revaluation, the Government postponed the production process switchover deadline. While 61.3% of the production capacity had changed to nonmercury cells, the remaining plants, with a total capacity of 1.8 million tons per year, could defer immediate conversion.

MINERAL FUELS

Coal.—Japan's coal mining industry reached its peak in 1960 when output exceeded 55 million tons and about 660 collieries were in operation. Subsequently, low-priced oil rivaled coal as Japan's primary fuel source, and the coal industry began closing mines and reducing employment year after year. By 1977, domestic production of coal by 8 companies with 29 collieries with 20,000 workers, was 18.3 million tons. Production during the year was by Mitsui Mining & Smelting Co., Ltd.; Hokkaido Colliery & Steamship Co., Ltd.; Taiheiyo Coal Mining Co., Ltd.; Mitsubishi Coal Mining Co., Ltd.; Sumitomo Coal Mining Co. Ltd.; Matsushima Coal Mining Co. Ltd.; Joban Coal Mining Co., Ltd.; and Kaijima Coal Mining Co., Ltd.

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The lack of domestic capacity to meet rising demand forced users to depend on overseas supplies. About 15 million tons of steam coal was imported to meet the annual estimated consumption of 22 million tons. Japan imports over 60 million tons of coal annually; the overwhelmingly large share is for metallurgical use.

Petroleum.—Japan's production of crude oil remained of little consequence, amounting to only 4.3 million barrels in 1977.[10] The cost for all fuels imported was $31,150 million, of which $25,791 million was for petroleum. There were 49 petroleum refineries in operation in Japan with a total crude oil distillation capacity of 5,940,360 barrels per stream-day (bpsd). Thirty-eight refineries (5,379,800 bpsd) were on the Pacific coast, five refineries (147,560 bpsd) on the coast of the Sea of Japan, three refineries (205,000 bpsd) in Hokkaido, and three refineries (208,000 bpsd) in Okinawa. The large concentration of refineries on the east coast reflects the location of the large consuming areas, harbors, and advantageous weather conditions.

As of yearend, Japan had 49 refineries owned by 31 companies, with a total atmospheric crude distillation capacity of 5,940,360 barrels per stream-day. Corresponding downstream capacities were as follows, in thousand barrels per day: Vacuum distillation, 1,858; catalytic cracking, 343; catalytic reforming, 598; middle distillates hydrodesulfurization, 1,288; fuel oil desulfurization, 1,281; hydrocracking, 13; lube oil solvent extraction, 72; lube oil solvent deasphalting, 49; lube oil solvent dewaxing, 61; sulfur recovery, 7,687 tons per day; and liquefied petroleum gas recovery, 24,879 tons per day.

Total crude oil throughput in 1977 was 4,284,000 barrels per stream-day, of which 4,276,000 was imported. Total throughput was 0.8% above the level of the previous year. Petroleum products produced during the year totaled 235,336,000 kiloliters, of which the largest volume was fuel oil, followed by naphtha, kerosene, jet fuel, lubricating oil, and other.

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[1]Physical scientist, Branch of Foreign Data.
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[3]Bureau of Statistics. Monthly Statistics of Japan. No. 206, August 1978, 136 pp.
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[5]Mining Journal (London). Mining Annual Review. June 1977, pp. 422-423.
[6]Japan Tariff Association. Japan Exports and Imports. V. 12, 1977, 1,724 pp.
[7]Work cited in footnote 5.
[8]Japan Economic Journal. Industrial Review of Japan. March 1978, 146 pp.
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The Mineral Industry of Kenya

By Janice L. W. Jolly[1]

Kenya's mineral production, excluding refined petroleum products, contributed more than $90 million[2] to the 1977 gross domestic product (GDP) valued at $3.9 billion at current prices. Kenya's economic growth continued through 1977, and its GDP grew 7.3% at constant 1972 prices.[3] Manufacturing output, including metal and petroleum products, increased 15% in volume in 1977, with the number of people in wage employment rising over 8%. Employment in the mining and quarrying sector was projected to increase rapidly to 10,000 persons by 1978. Buoyant domestic demand more than compensated for the decline in exports to Kenya's African neighbors, resulting from termination of the East African Community (EAC) and the consequent border closure with Tanzania. Public- and private-sector purchases of transportation equipment in the wake of the disintegration of the EAC rail and airways corporations accounted for nearly 40% of the increase in capital formation in 1977. Inflation of about 13% continued to be a problem.

Kenya received a $10 million credit from the International Development Association (IDA), a World Bank affiliate, for development of small-scale industries. The credit would be used for improvement and construction of factories and workshop clusters in Eldoret and Nairobi. Over the past 10 years, the World Bank has contributed financing for more than 40 projects in Kenya, with a total commitment of about $650 million.[4] The U.S. Agency for International Development (AID) also approved a loan of $13 million as well as a grant of $400,000 for construction of roads in western Kenya. The Kenyan link road with Sudan was to be financed by Norway and would cost about $8 million. The 230-kilometer road would be constructed between Lodwar in Kenya and Juba in southern Sudan.

Kenya Power Co. Ltd. was starting work on the geothermal deposits in the Okaria zone, which was expected to produce 170,000 kilowatts of energy per year. The project was estimated to cost $60.3 million and was being financed partly by long term loans from the World Bank and Commonwealth Development Corp. and partly by the company itself, which is owned by the Kenyan Government. Kenya's geothermal resources were estimated at 9 megawatts proven and 170 to 500 megawatts potential. Of Kenya's total 300 megawatts of installed electricity, 80% was oil-fired and 20% was hydroelectric. Kenya had contracted with the United Nations for a 1-year energy survey that was to focus mostly on rural applications. Alternatives to charcoal cooking were being sought in an effort to slow deforestation.

The Canadian Government agreed to loan $1.1 million to provide assistance to the Kenyan Mines and Geological Department in carrying out an airborne geophysical survey in which Canadian firms were to provide technology and equipment. The Canadian firm Terrasurveys would carry out magnetic and radiometric surveys over the coastal mineralized belt and selected parts of Nyanza and Western Provinces. Ground explorations were to follow. In addition, the Austrian company Austromineral was to map a 25,000-square-kilometer area in Taita-Taveta District with known deposits of asbestos, graphite, kaolin, and assorted gem stones. Marketing and processing studies were also to be done by the Austrian group.

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PRODUCTION AND TRADE

Mineral production in 1977 consisted of petroleum products produced from imported crude oil; limestone, limestone products, clinker, and cement, valued at $67 million; soda ash and salt, valued at $12.8 million; fluorspar, valued at $11 million; and gem stones, valued at $3.6 million. Other minerals of lesser significance produced for local use included clays, corundum abrasives, calcite, carbon dioxide, diatomite, feldspar, guano, gold, magnetite, and vermiculite.

Cement production at 1,144,429 tons was 16% above that of 1976. Cement shortages in parts of the country were becoming a problem, and the industry was in the process of expansion. The local price of cement was about $3.25 per 50-kilogram bag, although in western Kenya the price was somewhat higher. Cement exports for the first 6 months of 1977 were valued at nearly $11 million.[5]

Petroleum imports made up 12.8% of the total import value of $1.1 billion for 1977. East African Oil Refineries Ltd. (EAOR) at Mombasa processed about 18.7 million barrels of crude oil imported from Iran (35.1%), Saudi Arabia (34.9%), Qatar (21.5%), and Abu Dhabi (8.5%). Refined petroleum products exports made up 16% of the total export value of $1.4 billion, going to Tanzania, the Seychelles, Réunion, the People's Democratic Republic of Yemen, the Comoros, Italy, Singapore, Djibouti, and Japan.

The United States accounted for about 6% of Kenya's foreign trade. In 1977, the United States ranked fifth as a supplier of goods to Kenya and fourth as a purchaser of Kenyan exports. Fluorspar valued at about $1 million was exported to the United States in 1977. Imports from the United States included fertilizers valued at $3.1 million.[6]

The breakup of the EAC and the closure of the Tanzanian border precipitated a sharp drop in trade between the three former partner States of Kenya, Uganda, and Tanzania. Trade between Kenya and Tanzania was the most severely affected; Kenya's imports from Tanzania dropped 88.5%. Kenya's 1977 exports to Uganda, Rwanda, Sudan, Zambia, Somalia, Egypt, and Burundi included salt, cement, and petroleum products. The trade route between Zambia and Kenya was also interrupted by the Tanzanian border closure.

Table 1.—Kenya: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Beryl, gross weight	NA	1	--
Copper, mine output, metal content	70	(1)	--
Gold, mine output, metal content, troy ounces	r98	37	135
Iron and steel: Iron ore, gross weight	16,800	20,784	16,000
Lead, mine output, metal content[e]	1,100	480	--
Silver, mine output, metal content, troy ounces	84	118	--
NONMETALS			
Barite	r600	359	429
Cement, hydraulic	897,077	986,874	1,144,429
Clays, kaolin	NA	2	495
Corundum	NA	14	--
Diatomite	1,799	2,668	2,441
Feldspar	1,616	1,115	1,869
Fertilizer materials, crude, phosphatic and guano	297	219	55
Fluorspar	54,600	75,027	124,000
Gem stones, precious and semiprecious:			
Aquamarine, kilograms	NA	3	10
Garnet[2] do.	97	126	160
Ruby do.	293	810	532
Sapphire do.	NA	(3)	4
Tourmaline do.	214	20	23
Gypsum and anhydrite	18,038	78,020	25,999
Lime and limestone (except that for cement manufacture)	197,414	30,059	77,826
Magnesite	e10	3	3,575
Meerschaum	51	51	--
Salt:			
Crude	--	49,906	39,932
Refined	r5,553	14,250	12,300
Sodium compounds:			
Soda ash	91,733	108,763	109,444
Soda, crushed, raw	2,310	3,628	2,293

See footnotes at end of table.

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Table 1.—Kenya: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
NONMETALS —Continued			
Stone, sand and gravel:			
Calcareous:			
Calcite	150	NA	600
Coral (for cement manufacture)[e]	950,000	950,000	950,000
Kunkur (for cement manufacture)	133,830	176,798	44,914
Limestone (for cement manufacture)	181,038	193,157	50,197
Sand	11,530	16,994	17,665
Shale	[e]170,000	NA	NA
Talc (pyrophyllite)	--	--	270
Vermiculite	7,483	3,587	4,320
Wollastonite	60	120	300
MINERAL FUELS AND RELATED MATERIALS			
Carbon dioxide, natural	2,105	2,147	1,960
Petroleum refinery products:			
Gasoline, motor thousand 42-gallon barrels	2,988	3,091	3,112
Jet fuel do.	3,397	3,046	3,013
Kerosine do.	366	338	--
Distillate fuel oil do.	6,979	3,654	4,126
Residual fuel oil do.	6,067	7,504	7,395
Lubricants do.	35	--	--
Other:			
Asphalt do.	247	--	207
Liquefied petroleum gas do.	206	213	225
Unspecified do.	--	268	60
Refinery fuel and losses do.	761	974	781
Total do.	21,046	19,088	18,919

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.
[1]Revised to none.
[2]Quality (gem or industrial) not specified.
[3]Less than 1/2 unit.

Table 2.—Kenya: Exports and reexports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum metal including alloys:		
Scrap	431	485
Unwrought and semimanufactures value	[r]$208,534	$129,840
Copper metal including alloys:		
Scrap	759	555
Unwrought and semimanufactures value	[r]$22,875	$144,492
Iron and steel metal:		
Scrap	4,677	4,827
Semimanufactures:		
Bars, rods, angles, shapes, sections	1,682	1,503
Universals, plates, sheets	1,189	[2]1,749
Hoop and strip	157	95
Wire	174	407
Tubes, pipes, fittings	935	717
Castings and forgings, rough	11	--
Lead:		
Ore and concentrate	1,774	800
Metal including alloys:		
Scrap	2,431	459
Unwrought and semimanufactures	([3])	6
Magnesium metal including alloys, scrap	8	7
Tin metal including alloys, scrap	55	800
Zinc metal including alloys:		
Scrap	341	245
Unwrought and semimanufactures	--	72
Other: Ash and residue containing nonferrous metals, n.e.s	5	61
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, etc	632	542
Dust and powder of precious and semiprecious stones	--	1
Grinding and polishing wheels and stones value	[r]$354	$28,205
Barite and witherite do.	[r]$531	$3,962
Cement	550,419	601,338
Chalk value	[r]$80,697	$20,908

See footnotes at end of table.

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Table 2.—Kenya: Exports and reexports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976
NONMETALS —Continued		
Clays and clay products (including all refractory brick):		
Crude	72	306
Products	459	320
Diatomite and other infusorial earth	81	263
Feldspar and fluorspar	49,684	90,465
Fertilizer materials, manufactured:		
Nitrogenous[4]	1	213
Other, including mixed	--	3
Graphite, natural	73	(3)
Gypsum and plasters	3,093	124
Lime	2,907	5,524
Precious and semiprecious stones, except diamond, natural -- value, thousands	r$1,314	$1,227
Salt and brine	555	798
Sodium compounds:		
Caustic soda	209	767
Sodium carbonate (soda ash)	86,769	98,907
Stone, sand and gravel:		
Dimension stone, crude and partly worked	42	43
Dolomite	5	51
Gravel and crushed rock	1,018	41
Limestone, except dimension	--	1
Sand, excluding metal bearing	15	20
Sulfur:		
Elemental	--	1
Sulfuric acid, including oleum	16	19
Other:		
Crude -- value	r$396,208	$334,824
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	272	34
MINERAL FUELS AND RELATED MATERIALS		
Petroleum refinery products:[5]		
Gasoline -- thousand 42-gallon barrels	1,297	197
Kerosine -- do	550	69
Jet fuel -- do	1,369	2,117
Distillate fuel oil -- do	1,769	744
Residual fuel oil -- do	4,648	4,245
Lubricants -- do	422	214
Other:		
Liquefied petroleum gas -- do	56	30
Nonlubricating oils, n.e.s -- do	2	6
Bitumen and other residues and bituminous mixtures, n.e.s -- do	92	182
Unspecified -- do	1	4
Total -- do	10,206	7,808
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	381	712

rRevised.
[1]Includes transfers to Uganda and Tanzania.
[2]Excludes quantity valued at $209 in 1976.
[3]Less than 1/2 unit.
[4]Excludes quantity valued at $292 in 1975 and $150 in 1976.
[5]Includes bunkers.

Table 3.—Kenya: Imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum metal including alloys:		
Scrap	2	--
Unwrought	2	50
Semimanufactures	2,016	1,073
Copper metal including alloys:		
Scrap	11	70
Unwrought	5	24
Semimanufactures	843	[2]611
Gold:		
Metal -- troy ounces	4,985	652
Waste and sweepings -- do	29	322
Iron and steel:		
Ore and concentrate	--	10,500
Metal:		
Scrap	84	388
Pig iron, ferroalloys, similar materials	1,081	742
Steel, primary forms	13,496	29,906

See footnotes at end of table.

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Table 3.—Kenya: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS —Continued			
Iron and steel —Continued			
Metal —Continued			
Semimanufactures:			
Bars, rods, angles, shapes, sections		12,047	15,666
Universals, plates, sheets		49,775	85,363
Hoop and strip		1,418	1,530
Rails and accessories		3,744	3,357
Wire		8,603	12,533
Tubes, pipes, fittings		9,447	39,034
Lead metal including alloys:			
Unwrought		329	563
Semimanufactures		115	77
Magnesium metal including alloys, semimanufactures		1	11
Manganese ore and concentrate		639	1,056
Molybdenum metal including alloys, all forms		4	--
Nickel metal including alloys, unwrought and semimanufactures	value	[r]$29,012	$25,874
Platinum-group metals including alloys, all forms, but not rolled	troy ounces	39	34
Silver metal including alloys	do.	16,250	19,555
Tin metal including alloys:			
Scrap		365	199
Unwrought		21	28
Semimanufactures		[3]856	247
Zinc metal including alloys:			
Scrap and blue powder		2	11
Unwrought		876	2,156
Semimanufactures		665	[4]1,346
Other:			
Ores and concentrates of base metals, n.e.s		20	10
Metals including alloys, n.e.s.:			
Pyrophoric alloys	value	[r]$7,234	$37,509
Base metals		31	7
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc		6	2
Dust and powder of precious and semiprecious stones		1	([5])
Grinding and polishing wheels and stones		48	53
Asbestos		743	921
Barite and witherite	value	--	$1,708
Cement		330	1,009
Chalk	value	[r]$19,015	$9,385
Clays and clay products (including all refractory brick):			
Crude		[r]695	1,627
Products:			
Refractory (including nonclay brick)		3,583	2,223
Nonrefractory		1,250	1,281
Diamond, gem, not set or strung	carats	25	--
Diatomite and other infusorial earth		267	458
Fertilizer materials:			
Crude, phosphatic		17	--
Manufactured:			
Nitrogenous		44,379	20,104
Phosphatic		30,626	30,249
Potassic		682	3,920
Other, including mixed		33,146	25,554
Ammonia		152	381
Graphite, natural		11	24
Gypsum and plasters		123	823
Lime		1	2
Magnesite		8	102
Mica:			
Crude, including splittings and waste		21	15
Worked, including agglomerated splittings	value	[r]$6,955	$9,922
Pigments, mineral, natural, crude	do.	[r]$23,896	$14,385
Precious and semiprecious stones, except diamond:			
Natural	do.	[r]$17,713	$9,379
Manufactured	do.	[r]$17,773	$14,385
Salt and brine		1,262	2,400
Sodium and potassium compounds, n.e.s.:			
Caustic soda		3,470	7,594
Sodium carbonate (soda ash)		5	252
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked		194	123
Worked		25	259
Dolomite, chiefly refractory grade		303	362
Gravel and crushed rock, n.e.s		102	1
Quartz and quartzite		1	1
Sand, excluding metal bearing		457	222

See footnotes at end of table.

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Table 3.—Kenya: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS —Continued			
Sulfur:			
Elemental		614	1,099
Sulfuric acid, including oleum		1,213	1,780
Talc, steatite, soapstone, pyrophyllite	value	r$241,859	$219,366
Other:			
Crude	do	r$99,146	--
Slag, dross, and similar waste, not metal bearing		210	--
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		159	192
Coal and briquets:			
Anthracite and bituminous coal		43,914	61,990
Lignite and lignite briquets		1	--
Coke and semicoke		1,905	2,098
Peat, including peat briquets and litter		1	--
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	20,788	18,329
Refinery products:			
Gasoline	do	106	72
Kerosine and jet fuel	do	58	351
Distillate fuel oil	do	(5)	(5)
Lubricants	do	545	410
Mineral jelly and wax	do	9	16
Other:			
Nonlubricating oils, n.e.s	do	3	6
Unspecified	do	21	8
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		2,453	4,152

rRevised.
[1]Includes transfers from Uganda and Tanzania.
[2]Excludes quantity valued at $940.
[3]Excludes quantity valued at $1,477.
[4]Excludes quantity valued at $1,200.
[5]Less than 1/2 unit.

COMMODITY REVIEW

METALS

Columbium.—Of Kenya's pyrochlore occurrences, the Mrima carbonatite complex near Mombasa has received the most attention and has the most potential. The French firm Péchiney Ugine Kuhlmann was reportedly continuing an exploration and sampling program around the Mrima area. Gross reserves proven previously by Anglo American Corp. and the Kenyan Mines and Geological Department were given as 50.6 million tons with an average of 0.67% Nb_2O_5 to a depth of 30 feet over 87% of the hill. Four varieties of pyrochlore were described as occurring in the weathered rock capping; the most abundant was a barium pyrochlore, pandaite. A second variety was the brown, translucent, strontium-bearing type, while a third contained titanium in quantities up to 7.5%.[7]

Lead, Zinc, Silver.—At yearend, the Kenya Mining Industries Ltd. lead, zinc, and silver mine and treatment plant at Kinangoni was being offered for sale.[8] The receiver and manager of the mine was empowered to offer the sale of the mine en bloc. The mine was closed in early 1977. Reserves had been estimated at 5 million tons when mining began in 1973. Geomin of Romania, in partnership with Industrial and Commercial Development Corp. (ICDC) of Kenya, had mined out 2 million tons of ore. Metallurgical, water, and management problems brought about the closure.

NONMETALS

Barite.—Mineral Mining Corp. Ltd. produced barite from its mine located 50 miles from Mombasa. Production at a rate of about 2,000 tons per month provided feed for a new 24,000-ton-per-year screening and washing plant. The plant capacity is to be increased to 50,000 tons per year by 1979 with installation of a new flotation circuit.[9]

Carbon Dioxide.—Natural carbon dioxide was commercially exploited in two locations in Kenya. The gas was sold compressed for use in Kenya's bottling industry and as dry ice for use as a refrigerant. The two commercial wells have been producing since the early 1950's.

Cement.—The European Investment Bank, under the Lomé Convention agreement, loaned East African Portland Cement Co. Ltd. $3.4 million to finance expansion of its Athi River plant near Nairobi. Pro-

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duction capacity was to be increased 50% to 375,000 tons per year. East African Portland Cement was owned 50% by the Kenyan Government, 20% by private Kenyan shareholders, and 30% by Associated Portland Cement Manufacturers Ltd. of the United Kingdom and Cementia Holding AG of Switzerland. Kenya was using about 44% of its present cement production. Expansions of the Athi River plant and the Bamburi Portland Cement Co. Ltd. plant at Mombasa were expected to add 330,000 tons per year to the available supply by 1980. Bamburi Portland Cement's production at yearend 1979 was expected to be 1,160,000 tons, mostly for export. At yearend, a cement shortage persisted in northern Kenya, caused mostly by transportation problems.

Fluorspar.—Fluorspar Co. of Kenya Ltd. mined fluorite at its Kerio Valley mine, producing 124,000 tons valued at $11 million. Acid-grade fluorspar made up 85% of total production.[10] Development of reserves from both replacement and vein-type fluorite deposits continued.

Gem Stones.—Gem stone production included green garnet (locally called tsaverite), rhodolite, ruby, and sapphire. Also attracting interest were the garnets derived from areas along the Umba River near the Tanzanian border. Gem stone prospecting was reportedly increasing. The gem stone belt in Taita-Taveta District of Coast Province continued to be the major source of gem stones.

Salt.—Salt Manufacturers (Kenya) Ltd., a new firm, announced that Kenya would soon be self-sufficient in salt and would sell surplus for export. The company is to produce nearly 100,000 tons of marine salt when phase 2 of its newly acquired saltfields near Malindi, covering nearly 60 square kilometers, becomes fully operational within about 2 years.[11] About 12,300 tons of refined salt was produced in Kenya during 1977.

Soda Ash.—Soda ash continued to be produced from Magadi Soda Co.'s deposits at Lake Magadi in Rift Valley Province in southern Kenya. Dredging operations recovered about 109,000 tons of soda ash valued at $11 million during 1977.

MINERAL FUELS

Petroleum.—The 450-kilometer-long, 14-inch-diameter pipeline running from the EAOR petroleum refinery at Mombasa to a terminal in the industrial area of Nairobi was completed in November. The oilline is to be officially in service sometime during the first half of 1978, and an agreement was signed between Kenya Oil Pipeline Co. Ltd. (KPCL) and petroleum companies. The pipeline will deliver 90,000 gallons per hour. Costing about $100,000, it was built by firms from the United Kingdom and Japan. Materials used in the project came from the United Kingdom, Japan, the United States, and India.

Total Kenya, operator for the group Cie. Française des Pétroles (CFP)/Total (70%) and Elf-Aquitaine (30%), employed the exploration drillship *Le Pelerin* in a petroleum search offshore near Mombasa. The exploration permit covered over 5,000 square kilometers at a depth of nearly 1 kilometer.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Kenyan shillings (K Sh) to U.S. dollars at the rate of K Sh8.1 = US$1.00.

[3]U.S. Embassy, Nairobi, Kenya. Foreign Economic Trends and Their Implications for the U.S., Kenya. August 1978, p. 14.

[4]Standard Chartered Review (London). Kenya. December 1977, p. 8.

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[6]U.S. Embassy, Nairobi, Kenya. State Department Airgram A-55, Aug. 8, 1978, 14 pp.

[7]Du Bois, C. Minerals of Kenya. Ministry of Natural Resources, Geological Survey of Kenya. Bull. No. 8, 1966, pp. 126-127.

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[10]U.S. Embassy, Nairobi, Kenya. Minerals Questionnaire. State Department Airgram A-37, May 5, 1978, 1 p.

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The Mineral Industry of North Korea

By E. Chin[1]

The year 1977 marked the end of the fourth economic development plan (1971-77). It was generally believed that the Government's goals were overly ambitious, and the various sectors of the economy did not fulfill their goals;[2] hence, the plan, originally covering the period 1971-76, was extended another year. During this period, which was North Korea's first 7-year plan period, North Korea's development was hampered by recession and its inability to meet payments on the country's outstanding foreign debt. In 1973, the Government initiated new policies to achieve economic parity with its counterpart in the south, the Republic of Korea. In this plan, the Government began to import modern industrial equipment from market economy countries as well as from its allies. During 1974, purchases from market economy countries totaled $786 million, of which $253 million was for machinery. In 1975, these purchases were $560 million and in 1976 were reduced to $300 million. Beginning in 1975, however, the Government was unable to meet payment of part of its outstanding debt, which was then estimated at $1.3 billion and has escalated as a result of purchases in 1976-77. Reportedly, the People's Republic of China and the U.S.S.R. began reducing economic aid to North Korea. Also, the Government began to negotiate a repayment formula for its financial obligations to European and Japanese banks. While it was believed that agreement was reached on rescheduling payment on overdue debts, no official announcements were made. North Korea, however, was believed to have successfully negotiated terms of 2 to 5 years on repayment of overdue notes at an annual interest rate of 7.3% to 8%.

The fifth economic plan, which was the second 7-year plan (1978-84), calls for doubling and even tripling some output targets. While the present plan was "designed to further the strength of the country both in terms of economic independence and in strengthening the scientific-technical levels," the new economic plan "proposed high goals without precedent" and "is a grand economic program which anticipates rapid development."

The Government characterized the basic tasks of the second 7-year plan as follows: "During the new long-term plan period, we must further step up Chuche in the people's economy to permanently establish a strong source of fuel, motive power, and raw material bases in the nation. We must further strengthen the self-sufficient system of our economy by creating new industrial sectors, and by developing the economy with more diversity and comprehensiveness."[3]

During the new plan period, "industry will gallop at a highly accelerated rate, on the average of 12.1% annually." The proposed production goals of the fifth economic plan as well as the targets of the third and fourth plans were as follows, in million tons unless otherwise specified:

Sector	1970	1977	1984
Iron ore	7.2	NA	16.0
Pig iron	2.3	3.5-3.8	6.4-7.0
Steel:			
Crude	2.2	3.8-4.0	7.4-8.0
Rolled	1.7	r2.8-3.8	5.6-6.0
Nonferrous metals	.16	.45	1
Cement	4.0-4.5	7.5-8.0	12-13
Chemical fertilizers	1.5	2.8-3.0	5
Magnesium clinker	NA	1.6	NA
Coal	27.5	50-53	100
Electricity billion kilowatt-hours	16.5	28-30	56.60

rRevised. NA Not available.

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While the second 7-year plan projects slower growth, it has been conjectured that targets in key areas appear unrealistic.[4] Since 1975, North Korea has been cut off from additional credit from market economy countries, and no major import contracts have been signed. The goals for electric power, steel, and cement will probably not be met owing to the country's inability to import the required machinery and equipment.

PRODUCTION[5]

North Korea produces a variety of mineral commodities. Important minerals extracted are anthracite and bituminous coal, graphite, lead-zinc, magnesite, magnetite, and tungsten. In fact, North Korea is believed to be the world's second largest producer of magnesite, anthracite, and graphite; it is a medium-size producer of lead and zinc and a significant steel producer, following only Japan, China, and India in the Orient. Apatite, barite, copper, gold, and talc also are produced. The country has large reserves of coal, but petroleum and natural gas have not been discovered.

All of the country's mineral industries are State-owned. Moreover, the Government of North Korea does not publish mineral production data for dissemination. The production data given in table 1 denote a relative order of magnitude of North Korea's output of minerals and fuels. Output by the mineral sector comprises about 20% of the country's gross national product (GNP).

Government ministries and agencies which provide guidance and assistance to North Korea's mineral industries include the Ministry of Building Materials Industry (cement and construction), the Mining Industry Committee (coal and general mining), the General Bureau of Coal Industry, the General Bureau of Geology (surveying), the Ministry of Metallurgical Industry, and the Ministry of Chemical Industry.

Table 1.—North Korea: Estimated production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Aluminum, ingot, primary	10,000	10,000	10,000
Cadmium, smelter	110	120	130
Copper:			
Mine output, metal content	13,000	r15,000	15,000
Metal, primary and secondary:			
Smelter	18,000	20,000	20,000
Refined	18,000	25,000	25,000
Gold, mine output, metal content, troy ounces	160,000	160,000	160,000
Iron and steel:			
Ore and concentrate, thousand tons	9,400	9,500	9,700
Metal:			
Pig iron[2], do.	2,900	3,000	3,500
Ferroalloys, do.	100	100	120
Steel, crude, do.	2,900	3,000	3,500
Semimanufactures, do.	2,700	2,800	3,300
Lead:			
Mine output, metal content	120,000	r110,000	110,000
Metal, primary and secondary	80,000	r70,000	70,000
Silver, mine output, metal content, thousand troy ounces	1,600	1,600	1,600
Tungsten, mine output, metal content	2,150	2,150	2,150
Zinc:			
Mine output, metal content	160,000	r150,000	150,000
Metal, primary	140,000	r135,000	135,000
NONMETALS			
Barite	120,000	120,000	120,000
Cement, hydraulic, thousand tons	6,000	r7,000	7,000
Fertilizer materials, crude: Natural phosphate	450,000	450,000	450,000
Fluorspar	30,000	30,000	40,000
Graphite	75,000	75,000	75,000
Magnesite:			
Crude, thousand tons	1,500	1,500	1,500
Calcined, do.	500	500	500
Pyrite and pyrrhotite (including cupreous), gross weight	r640,000	r600,000	610,000

See footnotes at end of table.

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Table 1.—North Korea: Estimated production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]		1975	1976	1977[p]
NONMETALS —Continued				
Salt, all types		540,000	540,000	550,000
Sulfur:				
From pyrite	thousand tons	260	245	250
Byproduct of metallurgy	do.	16	20	12
Total	do.	276	265	262
Talc, soapstone, pyrophyllite		130,000	130,000	130,000
MINERAL FUELS AND RELATED MATERIALS				
Coal:				
Anthracite	thousand tons	32,000	33,000	34,500
Bituminous and lignite	do.	8,000	8,000	8,500
Total	do.	40,000	41,000	43,000
Coke	do.	2,200	2,500	3,000

[p]Preliminary. [r]Revised.

[1]In addition to the commodities listed, a variety of other mineral commodities may be produced, but available information is inadequate to make reliable estimates of output levels. These include (but are not limited to) antimony, arsenic (in arsenopyrite), asbestos, beryl, bismuth, boracite, kaolin (china clay), chromium, cobalt, columbite, germanium, indium, lithium minerals (lepidolite), manganese ore, mica (phlogopite), molybdenite, monazite, nickel and/or ferronickel, selenium, tellurium, titanium minerals (ilmenite and rutile), zircon, and a variety of crude construction materials including miscellaneous clays, glass sand, building sand, stone (crushed and dimension), and gravel.

[2]Includes granulated iron.

TRADE

Although all trade transactions are conducted by the Government, it does not publish official foreign trade data for dissemination. Trade data, given in tables 2 and 3, are derived from published import-export information of selected trading partner countries.

North Korea's total trade value in 1977 was probably around $1.0 billion to $1.5 billion. The country's chief exports are manufactured light industry goods, some raw materials, and foodstuffs. The leading mineral exports include iron ore, pig iron, steel semimanufactures, lead and zinc, tungsten, cement, magnesite, and talc. The country imports machinery and transportation equipment, mineral fuels, foodstuffs, and selected raw materials such as coal, coke, and chromium and manganese ores. North Korea's main trading partners were China, Japan, and the U.S.S.R., not necessarily in that order. Other trading partners have included Australia, Canada, Israel, New Zealand, European countries, and member countries of the Council for Mutual Economic Assistance.

The principal Government corporations that handle North Korea's trade in science and technology transfers, minerals, and value-added mineral products include Korea Complex Equipment Export Corp., Korea JEIL Equipment Import Corp., Korea Industrial and Technical Corp., Korea Technical Corp., Korea Machinery Export Corp., Korea Machinery Import Corp., Korea Minerals Export and Import Corp., Korea Ferrous Metals Export and Import Corp., Korea Nonferrous Metals Export and Import Corp., Korea Chemicals Export and Import Corp., Korea Building Materials Export and Import Corp., Korea Ponghwa Trading Corp., Korea Kwangmyong Export and Import Corp., Korea Daesong Trading Corp., Korea P'yongyang Trading Co., Ltd., and Korea Okryu Trading Corp.

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Table 2.—North Korea: Apparent exports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Copper metal including alloys:			
Scrap	795	596	All to West Germany.
Unwrought	2,708	2,951	West Germany 2,298; Belgium-Luxembourg 453.
Iron and steel metal:			
Pig iron	141,384	187,020	Japan 119,712; U.S.S.R. 34,307.
Ferroalloys	2,886	3,477	U.S.S.R. 3,380.
Steel, primary forms	5,147	7,097	All to Yugoslavia.
Semimanufactures	125,642	55,768	U.S.S.R. 55,754.
Lead metal including alloys, unwrought	62,620	[2]39,781	West Germany 18,714; Japan 11,627.
Silver, unworked and partly worked, value, thousands	$20,940	$12,913	West Germany $9,240; France $1,971; Japan $1,701.
Tungsten:			
Ore and concentrate	--	5	All to United Kingdom.
Metal	3	5	All to West Germany.
Zinc:			
Ore and concentrate	52,299	47,024	Yugoslavia 25,207; Japan 21,817.
Metal including alloys, unwrought	56,169	[2]38,812	Japan 27,277; France 3,973.
Other:			
Metal-bearing metallurgical residues	2,808	3,912	All to Japan.
Base metals including alloys, all forms, n.e.s	119	233	West Germany 181.
Nonferrous metals including alloys:			
Unwrought	--	[2]3,348	All to U.S.S.R.
Semimanufactures	--	[2]9,517	Do.
NONMETALS			
Clays, not further identified	9,096	11,535	Japan 11,280.
Cement, hydraulic, thousand tons	500	275	All to U.S.S.R.
Fertilizer materials: Ammonium nitrate	15,426	15,077	Do.
Fluorspar	4,350	2,434	All to Poland.
Graphite	20,356	7,063	All to Japan.
Magnesite, including powder	629,946	621,408	U.S.S.R. 342,835; Poland 116,877; Japan 92,840.
Stone, sand and gravel:			
Dimension stone, crude and partly worked	10,376	8,408	All to Japan.
Gravel and crushed rock	--	2,271	Do.
Quartz and quartzite	9,900	4,004	Do.
Talc, soapstone, steatite	119,349	47,465	Japan 38,892; Poland 8,573.
Other:			
Oxides of magnesium, strontium, barium	--	484	All to Finland.
Ground minerals	2,058	1,292	All to Hungary.
MINERAL FUELS AND RELATED MATERIALS			
Coal, anthracite and bituminous	36,938	70,036	All to Japan.

[1]Data are compiled from the 1976 edition of the United Nations Supplement to the World Trade Annual, v. 5, as well as official trade statistics of Hungary, Poland, and the U.S.S.R.

[2]1976 data exclude figures for the U.S.S.R., which are not broken down by individual metal but rather are reported as "Nonferrous metals including alloys: Unwrought and Semimanufactures."

Table 3.—North Korea: Apparent imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum metal including alloys, all forms	1,923	[2]1,199	Yugoslavia 697; Hungary 254; Japan 222.
Chromium ore and concentrate	20,000	11,000	All from U.S.S.R.
Copper metal including alloys, all forms	79	71	All from Japan.
Iron and steel metal:			
Pig iron	[r]1,242	1,500	All from Australia.
Ferroalloys	7,148	8,379	U.S.S.R. 7,812; Japan 567.
Semimanufactures:			
Bars, rods, angles, shapes, sections	NA	906	All from Japan.

See footnotes at end of table.

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Table 3.—North Korea: Apparent imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Iron and steel metal —Continued			
Semimanufactures —Continued			
Plates and sheets	NA	11,565	Japan 4,842; Bolgium-Luxembourg 4,827.
Hoop and strip	NA	87	All from Japan.
Rails and accessories	NA	400	Do.
Wire	NA	40	All from U.S.S.R.
Tubes and pipes	NA	3,273	Japan 1,728; U.S.S.R. 1,411.
Unspecified	--	3,197	All from U.S.S.R.
Total	37,670	19,468	
Lead ore and concentrate	--	3,728	All from Japan.
Manganese:			
Ore and concentrate	20,000	20,300	U.S.S.R. 20,000.
Oxide	--	2,700	All from Japan.
Nickel metal including alloys, all forms	255	50	Do.
Platinum-group metals including alloys value, thousands	--	$44	Japan $28.
Other:			
Oxides, hydroxides, peroxides of metals	--	10	All from Japan.
Nonferrous metals including alloys, unwrought	--	[2]192	All from U.S.S.R.
Metals including alloys, all forms, n.e.s	87	1	Do.
NONMETALS			
Abrasives: Grinding and polishing stones	--	4	Do.
Asbestos	3,341	[3]935	All from Australia.
Boron oxide and acid	--	60	All from Japan.
Clay products, refractory	10,681	3,044	Do.
Fertilizer materials, manufactured:			
Nitrogenous	15,000	2,200	Do.
Potassic	43,184	43,309	All from U.S.S.R.
Stone, dimension, worked	--	89	All from Japan.
MINERAL FUELS AND RELATED MATERIALS			
Coal, all grades thousand tons	189	167	All from U.S.S.R.
Coke do	204	222	U.S.S.R. [e]170; Poland 52.
Petroleum, crude, and refinery products do	1,110	1,061	All from U.S.S.R.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	--	51	NA.

[e]Estimate. [r]Revised. NA Not available.

[1]Data are compiled from the 1976 edition of the United Nations Supplement to the World Trade Annual, v. 5, as well as official trade statistics of Hungary, Poland, and the U.S.S.R.

[2]1976 data exclude figures for the U.S.S.R., which are not broken down by individual metal but rather are reported as "Nonferrous metals including alloys, unwrought."

[3]Excludes data for the U.S.S.R., which was not reported separately in the official trade statistics of the U.S.S.R.

COMMODITY REVIEW

METALS

Iron and Steel.—The current production capacity of iron ore and concentrate was around 11 million to 12 million tons. About 60% of the total production was from the Musan mine, which has an annual output capacity of 6.5 million tons. The Musan mine was reportedly undergoing expansion and modernization. The bulk of the remaining output was from the Chaeryong, Hasong, Kaech'on, Komdok, Songnam, Tokhyon, Unyul, and Yongwon mines, all of which were small- to medium-size mines. The iron ore deposits at Toksong and Sohaeri were still undergoing development.

Annual pig iron production capacity was estimated at 3.5 million tons and that of steel semimanufactures at 2.8 million tons. Most of the production was locally consumed. Kim Ch'aek Iron Works in Ch'ongjin was the largest iron and steel complex in North Korea. Kim Ch'aek had two 800-ton blast furnaces, one 1,500-cubic-meter blast furnace, two 100-ton converter units, a hot-rolling mill from the U.S.S.R., and four coke ovens. A hot- and cold-rolling mill of 1-million-ton annual capacity was under construction with Soviet aid. Construction of a fifth coke oven and a storage area for raw materials is in the planning stage.

Hwanghae Iron Works at Songnim had three 250,000-ton blast furnaces, six open-hearth furnaces, and two coke ovens. Kang-

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son Steel Works at Kangson's affiliate, April 13 Steel Works, had four rotary kilns for the production of granulated iron. The smaller steelworks in North Korea are the Kaech'on Rerolled Steel Plant at Kaech'on-gun, the Songjin Steel Works at Kimch'aek, the Puryong Alloy Plant at Ch'ongjin, and the P'yongyang Steel Plant at P'yongyang. Construction of a steelworks on the lower reaches of the Taedong River was planned. However, no information on the nature and status of this project is available.

Nonferrous Metals.—Lead and zinc continued to be the principal nonferrous metals produced in North Korea. The bulk of the domestic output of lead-zinc ore was from mines at Komdok and Songch'on. The country's lead-zinc smelters are located at Namp'o (zinc), Hamhung (55,000 tons of lead and 80,000 tons of zinc per year), and Munch'on-gun (the Munp'yong refinery, producing 70,000 tons of zinc per year). A lead-zinc refinery in the western district was planned, but construction had not been undertaken.

North Korea produces refined copper mostly from imported concentrate and from indigenous ore. The country's copper refineries are located at Hamhung (the Hungnam refinery, producing 30,000 tons of electrolytic copper per year), Haeju, and Namp'o. A copper refinery was reportedly under construction at Tanch'on-gun.

Small aluminum remelting facilities are located at Chinampo, Hungnam, and Tasado. Domestic requirements for aluminum are met by imports. However, a 20,000-ton-per-year aluminum smelter was planned for construction at Pukch'ang-gun.

North Korea annually provides about 5% of the world production of tungsten. The country also produces small quantities of antimony, cadmium, germanium, gold and silver, indium, lithium, manganese, molybdenum, nickel, and rare earths, but in most cases, information is inadequate to make reliable estimates of output levels.

NONMETALS

Cement.—The annual production capacity for cement using indigenous limestone was around 7 million to 8 million tons. About half of the total output was from the Sunch'on cement plant, the largest cement operation in the country. During the second 7-year plan, the Sunch'on plant was to be expanded to 5 million tons annual capacity. North Korea's cement facilities were as follows:

Plant	Location	Remarks
Ch'ongjin	Ch'ongjin (North Hamgyong).	
Ch'onnae-ri	Ch'onnae-ri (Kangwon)	5 rotary furnaces.
Haeju	Haeju (South Hwanghae)	4 rotary furnaces.
Kangson	Kangson.	
Komusan	Ch'ongjin (North Hamgyong)	2 rotary furnaces.
Kowon	Kowon-gun (South Hamgyong).	
Kujang	Kujang-gun (North P'yongan).	
Madong	Pongsan-gun (North Hwanghae).	
Pihyon	P'ihyon-gun (North P'yongan).	
Pukch'ang	Pukch'ang (South P'yongan).	
Purae-san	Kowon-gun (South Hamgyong)	2 rotary furnaces.
Pusan-ni	Pusan.	
Samhwasong	Munch'on-gun.	
Sinwon	Sinwon-gun (South Hwanghae).	
Sunch'on	Sunch'on-gun (South P'yongan)	3-million-ton-per-year capacity.
Sungho-ri	P'yongyang	4 rotary furnaces; 30,000-ton-per-year capacity.
Tokch'on	Tokch'on-gun (South P'yongan).	
Unsan	Unsan-gun (North P'yongan).	
Yongma	Paegam-gun (Yanggang).	

Fertilizer Materials.—Annual output of natural phosphate for fertilizers was around 450,000 tons. Small- to medium-scale phosphate fertilizer plants are located in almost all of the provinces. Based on Government estimations, North Korea's production level of chemical fertilizers currently ranges between 2.5 million and 3.0 million tons. Hungnam United Fertilizer was the largest producer of chemical fertilizers. Most of the remainder was from plants at Ch'ongsu and Sunch'on.

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Plant	Location	Remarks
Aoji	Kyonghung-gun	Nitrogenous, phosphatic, ammonium bicarbonate.
Ch'ongjin	Ch'ongjin	Calcium cyanamide.
Ch'ongsu	Ch'ongsu-gun	Phosphatic, trace elements, calcium cyanamide.
Haeju Phosphate	Haeju	Phosphatic.
Haeju Smelting & Refinery	do	Do.
Huich'on	Huich'on	Calcium cyanamide.
Hungnam Smelting & Refinery	Hungnam	Phosphatic.
Hungnam United Fertilizer	Hamhung	Superphosphate, ammonium sulfate, calcium cyanamide, trace elements.
Hwanghae	Songnim	Phosphatic, ammonium sulfate.
Kaech'on	Kaech'on-gun	Calcium cyanamide.
Kanggye Bacterial	Kanggye.	
Kim Ch'aek	Ch'ongjin	Ammonium sulfate.
Munp'yong	Munch'on-gun	Phosphatic, trace elements.
Namp'o	Namp'o	Phosphatic.
Sinch'on	Sinch'on-gun	Calcium cyanamide.
Sinwon	Sinwon-gun	Slaked lime.
Sunch'on	Sunch'on-gun	200,000-ton-per-year capacity for calcium cyanamide.

MINERAL FUELS

Coal.—North Korea's major domestically produced fuel source is coal. Output in 1977 was about 43 million tons, compared with the target of 50 million to 53 million tons set in the fourth economic development plan ending in 1977. The total output was consumed locally for space heating and electricity generation. The remainder was bituminous coal, reportedly of good metallurgical grade. The Chollima Sinch'ang coal mine is the nation's largest producer. Additionally, there are large opencast workings at Yonghung. Additional coal production came from mines at Chik-tong, Ch'onsong, Huksong, Kaech'on, Kangdon, Kangso, Komdok, Kowon, Musan, Taedae-ri, Tokch'on, Toksong, Yongdae, and Yongmun. The mines at Kukdong and Yangjong were reportedly capable of producing up to 1 million tons of coking coal annually. Additionally, the mines at Aoji and Kogonwon were claimed to have produced large quantities of high-grade metallurgical coal.

Petroleum.—There are no known commercial occurrences of oil or natural gas in North Korea. Domestic demand for petroleum has been met through imports, principally from China and the U.S.S.R. A pipeline completed in late 1975 delivers Taching oil from China to North Korea. An oil refinery was built at Namhung to process Chinese crude oil and to provide naphtha feedstock for a petrochemical plant purchased from European concerns in 1971. The oil refinery on the eastern coast, which reportedly came onstream in 1974-75, presumably handles imports of crude oil from the U.S.S.R.

[1]Physical scientist, Branch of Foreign Data.
[2]Asia 1977 Yearbook (Hong Kong). Far Eastern Economic Review Limited. Dec. 21, 1976, pp. 255-259.
[3]Work cited in footnote 2.
[4]National Foreign Assessment Center. Washington, D.C. Korea: The Economic Race Between the North and the South. January 1978, 16 pp.
[5]Mining Journal, Mining Annual Review (London). June 1977, p. 398.

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The Mineral Industry of the Republic of Korea

By E. Chin [1]

During the third 5-year economic development plan, the gross national production (GNP) of the Republic of Korea grew at an average annual rate of about 11% between 1972 and 1976. In constant 1970 prices, the GNP in 1977 was $16.9 billion,[2] a real growth of 10.37% over that in 1976. In terms of current prices, the GNP reached $31.5 billion[3] in 1977, an increase of 26% over the 1976 GNP. By sectors, mining and quarrying accounted for only 1% of the GNP in 1977, compared with 29% for manufacturing; 37% for communications, power utilities, and other public services; and 33% for other goods and services. Output in the manufacturing sector was estimated at $9.1 billion in 1977. Minerals-related components in this sector, in million dollars, included chemicals and chemical products, 680; petroleum and coal products, 865; primary metals, 317; and fabricated and assembled metal products, 124. Thus, the Republic of Korea is like a smaller scale Japan, producing large amounts of mineral and metal products but not too many crude minerals.

Production indexes (1975=100) for the major components of the mining, mineral processing, and fuels sectors for the last 5 years follow:[4]

	1973	1974	1975	1976	1977
Mining:					
Coal, anthracite	77	87	100	93	99
Metallic ores	91	95	100	111	121
Nonmetallic ores	84	90	100	117	138
Primary metals:					
Iron and steel	49	94	100	141	171
Nonferrous metals	62	71	100	143	179
Industrial chemicals	68	77	100	124	147

Led by a 29% jump in cost for agricultural and marine food items, wholesale prices rose 9% in 1977, compared with 12% in 1976. Import prices, which nearly doubled between 1972 and 1974, increased only 0.9% during 1977. Consumer prices advanced 10%, resulting chiefly from a 26% increase in the cost of fuel and electricity.

The fourth 5-year economic development plan (1977-81) calls for an average annual economic growth rate of 9.2% during the plan period, whereby the GNP would reach 16,214 billion won (W) in 1981, in 1975 prices.[5] The growth in the primary industry sector was projected at 4% per year, compared with 14.2% for mining and manufacturing and 7.6% for tertiary industries. The population was projected to grow at 1.6% annually, reaching 38.8 million in 1981. Per capita GNP was expected to expand from $847 in 1977 to $1,512 in 1981. Domestic financing of W18,008 billion (1975 prices) was to be invested during the 5-year period for various projects envisaged in the economic development plan. Additionally, inflow of capital from foreign loans and investments was projected to be around $10 billion for the plan period. In 1975 constant prices, exports were to grow at 16% per year, reaching $14.2 billion in 1981, while imports would increase 12% per year to $13.8 billion in 1981. Accordingly, the visi-

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ble trade balance would sustain a deficit in 1978-79 and yield a surplus beginning in 1980. Employment was to increase by 3.2% annually to 14.8 million in 1981. In particular, employment in the mining-manufacturing sector was to expand by 7.5% per year during the period, creating employment for 1.2 million persons.

Targets of the economic development plan applicable to the mining industry were to complete the basic survey investigation of mineral resources, maximize economic development of mineral resources, reinforce the policy inducing development of mineral resources, and utilize mineral resources for efficient and economic consumption. To reach these goals, assistance and subsidy would be provided to increase production of mineral raw materials for the secondary and tertiary industries; geologic investigation and exploration programs were to be enlarged; systematic efforts were to be made in increasing gold production and in the exploration and development of nuclear fuel minerals; processing facilities were to be upgraded and modernized in order to produce manufactured goods rather than beneficiated mineral raw materials; mine facilities were to be updated with installation of new equipment utilizing modern technology; mining support was to be enhanced by increasing tax exemptions for mining investment and exploration and by other incentives; and lastly, development of foreign mineral resources was to be encouraged. As for coal, Korea's leading mineral product, there was to be an intensification of exploration activities; expansion of production facilities and improvement in extraction technology; establishment of an inducement system to encourage coal mine development; and programs to develop efficient utilization of coal.

Under a long-term energy supply-demand study (1977-81) drafted in 1976, the annual growth rate in demand for energy was estimated at 9%. Total energy demand in 1977 was estimated at 66.6 million tons in terms of standard coal equivalent (SCE) and was projected to reach 93.1 million tons SCE in 1981. In 1977, the domestic configuration of energy demand was estimated as follows, in million tons SCE: Oil, 37.7; hydroelectric and nuclear power, 1.0; charcoal, 6.1; and coal, 21.8. During the fourth economic development period, W355,906 million was to be invested in the development of the coal mining industry; W287,906 million in the oil refining industry; and W2,390 billion for electricity generation and electrification.

On September 10, 1977, the Government's Organization Law was revised and a Ministry of Energy and Resources was established, effective January 1, 1978. The new Ministry was to assume the administrative functions related to resources and energy formerly vested in the Ministry of Commerce and Industry, and will be responsible for developing and controlling mineral and energy resources on a long-term basis for the country. In addition to offices for mine registration, and planning and management, the Ministry consists of five bureaus: Planning, resources development, electricity, petroleum, and coal.

On February 10, 1977, the President disclosed a Government plan to construct a temporary administrative capital south of Seoul. No site was selected for the new capital, and land procurement and construction were not expected to begin until the 1980's. Relocation of the capital was regarded as a means to control the rapidly growing population of Seoul.

Kuma Expressway, which links Taegu, center of the southeastern inland industrial sphere, with Masan, a large free export zone, was opened to traffic on December 17, 1977. Ch'angwon, close to Masan, is a large-scale-machinery industrial complex which is expected to be further enlarged under the heavy industry expansion plan. Kuma Expressway is an 84.5-kilometer, two-lane road. Construction began in June 1976, and total cost of the project was W23.7 billion.

Test operation of the Kori nuclear reactor began on June 19, 1977. Westinghouse Electric Corp. was the main contractor for the installation of the pressurized-water reactor, which has a rated generating capacity of 595,000 kilowatts. The cylindrical reactor containment vessel is 36 meters in diameter and rises 60 meters above ground with 10 meters below ground level. The reactor surface is covered with 3.7-centimeter-thick steel plates, and the outer containment walls consist of 1-meter-thick reinforced concrete. The Kori unit has one high-voltage turbine generator and two low-voltage turbine generators. Power generation cost was estimated at W9.21 per kilowatt-hour, compared with W14.37 for thermal powerplants. The reactor uses enriched uranium-235 as fuel, and 48 tons of enriched uranium have been stockpiled, which is sufficient to fuel the reactor for 3 years. Full operation of the Kori unit was not expected until 1978 because of malfunction of steam pipes.

The Ministry of Energy and Resources

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proposed the construction of seven additional nuclear power units by 1986. A 678,000-kilowatt reactor was to be constructed in 1982, a 650,000-kilowatt reactor in 1983, a 900,000-kilowatt reactor in 1984, two 900,000-kilowatt reactors in 1985, and two more 900,000-kilowatt reactors by the end of 1986.

The Value-Added Tax Law, promulgated on December 22, 1976, became effective on July 1, 1977. Seven indirect taxes (business, commodity, textile products, electricity and gas, admission, petroleum products, and transportation) and one local tax (restaurant service) were absorbed into the newly created tax system. A uniform tax rate of 13% was to be imposed, which, however, was reduced to 10%. Items exempt from the value-added tax included daily necessities such as foods, social welfare services, export goods, and foreign-exchange-earning goods and services. The major objectives of the new tax system were to simplify tax collection and administration, promote exports and investments, abolish overlapping tax assessments, encourage formation of integrated enterprises, and eliminate tax evasion.

On November 6, 1977, a fire swept through a coal pit in the Changsung mine, Kangwon Province, injuring 80 miners and killing 12. The fire, caused by an explosion of a high-voltage power transformer situated in a shaft 350 meters below the surface, was brought under control on November 22. The Changsung mine, owned by the state-run Dai Han Coal Corp. (DHCC), produces about 1.9 million tons of coal per year and employs about 5,000 miners.

During the year, construction activities were brisk because of expanded activities by individual, private, and Government contracts in various projects. Construction permits approved were classified as follows, in square meters: 12.9 million for 117,801 new housing units; 3.6 million for 13,931 commercial and service structures; 3.4 million for 3,595 industrial structures; and 2.4 million for 7,126 educational and other structures. Construction of 10 plants was completed during the year, including a 250,000-ton steelmaking plant at Ch'angwon Machinery Industrial Complex, and a 50,000-ton polyvinyl chloride plant and a 6,000-ton acrylonitrile butadiene styrene plant at Yochon Petrochemical Industrial Complex. The Ministry of Construction estimated that foreign contracts totaling $3.4 billion were won by Korean firms in 1977. The number of domestic firms involved in overseas construction projects increased from 53 in 1976 to 64 in 1977, involving various projects in 26 foreign countries.

In early December, the Government announced measures to liberalize import restrictions in 321 commodity items, which would be put into effect beginning on May 1, 1978, until the end of 1982. Under the first stage of the new import liberalization policy (May 1 to December 31, 1978), 133 items would be freed from the import-prohibited or import-restricted category. The remaining 188 liberalizations would occur during 1979-82. On December 22, 1977, Korea's exports reached the $10 billion mark, making Korea 26th in the list of the world's top exporting countries.

On December 16, 1977, the National Assembly approved legislation to extend the Republic of Korea's territorial waters from 3 miles to 12 miles.

PRODUCTION

The Republic of Korea is a major world producer of anthracite, graphite, kaolin, pyrophyllite, talc, and tungsten.[e] Other mineral commodities mined locally include copper, iron ore, fluorspar, lead, zinc, and limestone. The overall mining production index in 1977 was 159.3 (1970=100), compared with 136.5 for metallic minerals, 228.8 for nonmetallic minerals, and 139.8 for coal. In addition, Korea produces primary metals, such as aluminum, copper, and iron and steel, from imported ores and concentrates. Domestic production of limestone is significant, about 22 million tons, and is used primarily in cement manufacture. The domestic capacity to produce cement is around 16 million tons. About three-quarters of the cement production is consumed domestically with the remainder exported.

There was no domestic production of oil and natural gas. In addition to coal and hydropower and nuclear power generation, Korea imports crude petroleum and coal to meet its energy demands. The production index for oil refining in 1977 was 130.2 (1975=100), an increase of 11.4% from the previous year. Total oil refining capacity at yearend 1977 was 435,000 barrels per day. The principal petroleum refinery products produced during the year were bunker oil, diesel oil, naphtha, and gasoline, in that order.

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Table 1.—Republic of Korea: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Aluminum metal, primary	[r]17,755	17,946	18,340
Antimony, mine output, metal content	[r]40	10	--
Arsenic, mine output, white arsenic equivalent	[e]100	709	491
Bismuth metal	113	174	134
Cerium, metallic	[e]90	--	--
Copper:			
Mine output, metal content	2,671	2,255	1,748
Smelter	20,300	29,700	42,000
Metal, refined, including secondary	[r]21,957	30,911	42,880
Gold metal troy ounces	13,343	18,744	21,380
Iron and steel:			
Iron ore and concentrate, gross weight thousand tons	644	755	791
Pig iron do	1,186	1,937	2,425
Ferroalloys do	[r]42	65	64
Crude steel (excluding castings) do	2,010	2,698	2,737
Lead:			
Mine output, metal content	12,164	14,533	16,552
Metal, smelter	5,739	7,781	6,742
Manganese ore and concentrate, gross weight	3,160	1,383	664
Molybdenum, mine output, metal content	76	120	101
Rare-earth metals, monazite concentrate, gross weight[e]	10	10	10
Silver metal thousand troy ounces	1,504	1,858	2,106
Tin, mine output, metal content	4	35	15
Titanium, ore and concentrate, gross weight[e]	160	160	160
Tungsten, mine output, metal content	2,444	2,587	2,635
Zinc:			
Mine output, metal content	45,919	59,136	68,355
Metal, primary	[r]20,937	27,548	32,756
Zirconium concentrate, gross weight	[e]20	--	--
NONMETALS			
Asbestos	4,345	4,762	6,180
Barite	2,062	4,174	2,645
Cement, hydraulic thousand tons	10,129	11,873	14,196
Clays, kaolin	[r]513,176	470,251	534,591
Diatomaceous earth	19,285	13,483	22,980
Feldspar	20,138	206,208	49,374
Fertilizer materials, manufactured:			
Nitrogenous (urea) thousand tons	925	848	1,126
Phosphatic (magnesium phosphate) do	[r]195	148	111
Mixed do	715	774	1,138
Fluorspar, metallurgical-grade	28,296	20,270	12,981
Graphite:			
Crystalline	2,339	3,413	3,446
Amorphous	44,893	38,277	62,509
Kyanite and related materials, andalusite	106	520	115
Lime, slaked thousand tons	[e]100	[e]110	60
Mica, sericite	[e]3,000	5,314	10,133
Pyrite, gross weight	1,664	1,632	--
Sodium compounds, sodium carbonate, manufactured	127,103	155,457	170,467
Stone, sand and gravel:			
Crushed and broken limestone thousand tons	16,904	19,099	22,734
Quartzite do	265	298	333
Sand (including glass sand) do	262	301	335
Sulfur, content of pyrite	499	490	--
Talc and related materials:			
Pyrophyllite	322,967	348,694	433,304
Talc	92,907	147,774	171,926
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	23,884	31,646	38,248
Coal, anthracite thousand tons	17,593	16,427	17,268
Coke do	[r]549	960	1,165
Fuel briquets, anthracite briquets do	[e]11,000	[e]11,000	NA
Peat[e]	4	4	--
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	4,173	5,332	7,007
Jet fuel do	4,251	4,958	5,835
Kerosine do	3,946	4,244	4,486
Distillate fuel oil do	20,816	25,628	30,400
Residual fuel oil do	62,380	68,354	79,860
Other do	19,407	17,368	25,808
Refinery fuel and losses do	2,742	6,523	4,109
Total do	[r]117,715	132,407	157,505

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

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TRADE

Overall trade for the Republic of Korea in 1977 was close to $20.86 billion; the value of imports was $10.81 billion, compared with $10.05 billion for exports.[7] By area, exports to Far East and Middle East countries were valued at $4.3 billion; to North America, $3.5 billion; Europe, $1.86 billion; Africa, $0.3 billion; Oceania, $0.1 billion; and South America, $0.05 billion. By far the largest individual export destinations were the United States, $3.1 billion, and Japan, $2.1 billion. By commodity classifications, exports of textile were $2.9 billion, by far the largest category, followed by animal and vegetable products, $1.1 billion; and mechanical and electrical machinery and appliances, $1.0 billion. The value of exports of metals and semimanufactures in 1977 was $995.8 million; for mineral products, $358.1 million; and for chemicals, $211.9 million.

Sales of domestically produced minerals and metals to foreign markets increased 27.3% over the 1976 level in 1977, and 38.5% over the 1977 export target set by the Government in the current economic plan. By value, the leading mineral export commodities included tungsten, talc, zinc ore, kaolin, and anthracite.

Imports by area in 1977 were as follows, in billion dollars: Far East and Middle East countries, 6.7; Europe, 0.9; North America, 2.6; South America, 0.07; Africa, 0.08; and Oceania, 0.3. Imports of mineral products were the largest category by value; receipts of mineral fuels at $2.2 billion constituted 91% of the total imported in this class. Imports of other major commodity categories included mechanical and electrical machinery and appliances, $2.3 billion; animal and vegetable products, $0.93 billion; and chemicals, $0.86 billion.

Table 2.—Republic of Korea: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum metal including alloys, all forms	595	2,809
Bismuth metal including alloys	r150	76
Chromium:		
Ore and concentrate	--	136
Oxides and hydroxides	1	--
Copper:		
Ore and concentrate	(1)	--
Metal including alloys, all forms	440	878
Iron and steel:		
Ore and concentrate thousand tons	62	4
Scrap do	r(2)	19
Pig iron, ferroalloys, similar materials do	11	20
Steel, primary forms do	218	262
Semimanufactures:		
Bars, rods, angles, shapes, sections do	r26	242
Universals, plates, sheets do	r347	649
Hoop and strip do	(2)	(2)
Rails and accessories do	1	(2)
Wire do	10	6
Tubes, pipes, fittings do	r183	255
Castings and forgings do	17	28
Total	r584	r1,180
Lead:		
Ore and concentrate	6,710	8,360
Metal including waste and sweepings	44	74
Molybdenum:		
Ore and concentrate	52	50
Trioxide	10	1
Metal	--	7
Nickel metal	1	1
Platinum-group metals and silver:		
Ore and concentrates	3,200	4,250
Metal including alloys troy ounces	6,044	6,025
Selenium	(2)	--
Tin:		
Ore and concentrate	22	742
Metal including alloys, all forms	2	--

See footnotes at end of table.

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Table 2.—Republic of Korea: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS —Continued		
Tungsten:		
Ore and concentrate	r3,278	2,366
Metal including waste and scrap	26	315
Zinc:		
Ore and concentrate	47,620	48,786
Oxide	266	254
Metal including alloys, all forms	330	206
Other:		
Ash and residue containing nonferrous metals	320	173
Base metals including alloys, all forms, n.e.s	65	104
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum	21	210
Grinding and polishing wheels and stones	32	90
Asbestos	124	16
Barite	45	--
Cement and clinker	r2,439,374	3,602,423
Chalk	2	--
Clays and clay products:		
Crude:		
Kaolin	109,340	119,818
Other	r35,784	43,826
Products:		
Refractory	r349	315
Nonrefractory	r49,975	81,124
Diamond:		
Gem, not set or strung, thousand carats	r165	150
Industrial, do	10	--
Diatomaceous earths	70	300
Feldspar	r5,268	11,851
Fluorspar	10,730	6,607
Other	492	150
Fertilizer materials:		
Crude	210	30
Manufactured, nitrogenous	1	84,245
Graphite, natural	35,500	41,141
Gypsum and plasters	66,470	89,760
Mica, all forms	r1,901	1,061
Pigments, mineral, and processed iron oxides	35	--
Precious and semiprecious stone, except diamond, including synthetic, kilograms	53,731	59,765
Salt	138	221
Sodium and potassium compounds, n.e.s	20,274	26,457
Stone, sand and gravel:		
Dimension stone	r60,097	66,619
Dolomite, chiefly refractory grade	93,150	193,200
Gravel and crushed stone	9,023	5,922
Limestone	240	--
Quartz and quartzite	114,236	105,218
Sand, excluding metal bearing	13,316	11,827
Talc, crude and ground (including natural steatite)	42,212	68,114
Other nonmetals, n.e.s.:		
Crude:		
Other	176,682	225,071
Slag, dross and similar waste, not metal bearing	56,242	58,842
Oxides, hydroxides, and peroxides of strontium, barium, and magnesium	10	--
MINERAL FUELS AND RELATED MATERIALS		
Coal, coke, peat	1	10,657
Petroleum refinery products:		
Gasoline	910	3,479
Jet fuel	1,435	1,065
Kerosine	r411	630
Distillate fuel oil	1,661	3,156
Residual fuel oil	925	876
Lubricants	397	7
Other	r2,108	939
Total	r7,847	10,152
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	34,602	16,836

rRevised.
1Revised to none.
2Less than 1/2 unit.

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Table 3.—Republic of Korea: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum:		
Bauxite and concentrate	800	620
Oxide and hydroxide:		
For use in manufacturing aluminum	32,605	33,880
Other	9,167	15,363
Metal including alloys, all forms	23,568	71,934
Arsenic trioxide, pentoxide acid	3	2
Beryllium metal including alloys, all forms ____ kilograms	92	157
Chromium oxide and hydroxide	514	916
Cobalt:		
Oxide and hydroxide	r7	13
Metal including alloys, all forms	3	7
Copper:		
Ore and concentrates	29,030	67,859
Matte	73	2,216
Metal including alloys, all forms	35,015	39,488
Iron and steel:		
Ore ____ thousand tons	1,494	1,187
Metal:		
Scrap ____ do	844	1,093
Pig iron, ferroalloys, similar materials ____ do	r75	121
Steel, primary form ____ do	564	896
Semimanufactures:		
Bars, rods, angles, shapes, sections ____ do	241	324
Universals, plates, sheets ____ do	285	325
Hoop and strip ____ do	38	74
Rails and accessories ____ do	11	36
Wire ____ do	14	45
Tubes, pipes, fittings ____ do	32	35
Casting and forgings, rough ____ do	(1)	1
Total ____ do	621	840
Lead:		
Oxides	215	--
Metal including alloys, all forms	8,312	11,000
Magnesium metal including alloys, all forms	103	211
Manganese:		
Ore and concentrate	43,513	109,619
Oxide and hydroxide	713	1,215
Mercury ____ 76-pound flask	920	1,221
Molybdenum metal including alloys, all forms	8	21
Nickel:		
Matte, speiss, similar materials	35	53
Oxide and hydroxide	r2	
Metal including alloys, all forms	1,006	2,484
Phosphorus, elemental	25	54
Platinum-group metals and alloys ____ troy ounces	32,601	17,867
Rare-earth metals including alloys	r(1)	1
Selenium, elemental	1	4
Silicon, elemental	142	163
Silver ____ thousand troy ounces	377	32
Tin:		
Ore and concentrate	10	295
Oxides	(1)	1
Metals including alloys, all forms	1,073	1,250
Titanium:		
Ore and concentrates:		
Rutile	1,675	2,343
Ilmenite	5,222	15,861
Oxides	3,087	1,790
Tungsten metal including alloys, all forms	r6	15
Vanadium pentoxide	2	2
Zinc:		
Oxide	267	268
Metal including alloys, all forms	5,757	12,367
Other:		
Ore and concentrate of base metal, n.e.s	r83	140
Ash and residue containing nonferrous metal	470	44
Metals including alloys:		
Metalloids	2	53
Pyrophoric alloys	(1)	1
Base metals including alloys, all forms, n.e.s	100	110
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, etc	688	1,416
Dust and powder of precious and semiprecious stones including diamond ____ kilograms	5,321	180,790
Grinding and polishing wheels and stones	423	342

See footnotes at end of table.

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Table 3.—Republic of Korea: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976
NONMETALS —Continued		
Asbestos	56,960	74,206
Barite	906	--
Boron materials:		
Crude natural borates	81	2
Oxides and acid	875	1,128
Bromine	1	--
Cement, hydraulic	1,817	850
Clays and clay products (including all refractory brick)		
Crude clays, n.e.s	11,867	19,746
Products:		
Refractory (including nonclay bricks)	53,544	13,280
Nonrefractory	r75	12
Diamond, industrial thousand carats	r50	136
Diatomite and other infusorial earth	15	--
Fertilizer materials:		
Crude phosphatic	r705,880	746,367
Manufactured:		
Nitrogenous	r14,343	12,042
Phosphatic	172,516	456
Potassic	r336,875	229,412
Other, including mixed	2,540	16
Ammonia	2,144	3,560
Fluorine, elemental	(1)	--
Graphite, natural	1	2
Gypsum and plasters	r864	3,416
Iodine	5	4
Lime	36	5
Magnesite, crude, calcined, and magnesia clinker	5	2,600
Mica, all forms	191	170
Pigments, mineral, including processed iron oxides	r3,103	462
Precious and semiprecious stones, except diamond including synthetic kilograms	72,084	178,905
Pyrite, unroasted	4,583	--
Salt	311,581	517,967
Sodium and potassium compounds, n.e.s	r13,087	37,126
Stone, sand and gravel:		
Dimension stone, crude and partly worked	r134	629
Dolomite, chiefly refractory grade	145	341
Gravel and crushed rock	--	7
Limestone	15,742	--
Quartz and quartzite	84	85
Sand, excluding metal bearing	189	238
Sulfur:		
Elemental	r228,346	292,451
Sulfur dioxide	11	16
Sulfuric acid	39	44
Talc, steatite, soapstone waste, not metal bearing	33	60
Other nonmetals, n.e.s.:		
Crude	2,777	8,520
Slag, dross and similar waste, not metal bearing	1	1
Oxides, hydroxides, and peroxides of magnesium, strontium, and barium	r250	610
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	54	229
Carbon black and gas carbon	2,887	1,778
Coal, all grades, including briquets	671,494	1,494,001
Coke and semicoke	114,618	92,432
Gases, rare	97	216
Helium	4	3
Petroleum:		
Crude and partly refined thousand 42-gallon barrels	121,856	132,097
Refinery products:		
Gasoline	16	77
Kerosine	31	9
Distillate fuel oil	70	2,027
Residual fuel oil	2,799	5,167
Lubricants	496	702
Other	405	369
Total	3,817	8,351

rRevised.
[1]Less than 1/2 unit.

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COMMODITY REVIEW[8]

METALS

Aluminum.—Total output of primary aluminum was by one company, Aluminum of Korea, Ltd. (Koralu) at its reduction plant at Ulsan. Koralu, a 50-50 joint venture of the Korean Industrial Bank and Péchiney Ugine Kuhlmann (PUK), has an annual production capacity of 18,000 tons of aluminum metal. Koralu imports alumina for its smelter and in 1977 received 197,064 tons from Japan and 168,930 tons from Malaysia. The domestic demand for aluminum was estimated at 65,000 tons per year. During the year, receipts of unwrought metal totaled 68,337 tons, mostly from Japan, Canada, and Bahrain. The Korean Industrial Bank was negotiating with PUK for possible expansion of the Ulsan smelter capacity to 72,000 tons per year or for the construction of a 100,000-ton-per-year smelter at Onsan.

Copper.—Production of copper concentrate in 1977 was almost 12,000 tons, averaging 15% copper. The Kumpuk copper mine at Kyunsang Nando accounted for the bulk of the Nation's copper ore output. Imports of copper ores and concentrates totaled 55,766 tons, of which the Philippines supplied 66%; waste and scrap imports of 54,360 tons were mostly from the United States; and unwrought metal and ingot imports totaled 14,093 tons, of which 58% was from Japan. Close to 75% of the total production of electrolytic copper was by the Changhang smelter owned by Korea Mining & Smelting Co., Ltd., which has an annual capacity of 37,700 tons of metal.

To meet increasing demand for copper, an 80,000-ton-per-year smelter-refinery was being constructed by a consortium of United Kingdom, Belgium, and Finnish interests at the nonferrous metals industrial complex at Onsan. By yearend, construction was well underway and on schedule, and commissioning of the $180 million smelter-refinery was expected in early 1979. Onsan Copper Refinery Co., Ltd., is owned 50% by the Korea Development Bank, with the remaining equity held by three private companies. Onsan Copper will produce cathode copper, sulfuric acid, gold, and silver.

Iron and Steel.—Mine production of iron ore was around 791,000 tons in 1977. Almost half of the domestic mine output was from the Yangyang mine in Kangwon Province operated by Dai Han Iron Mining Co., Ltd. Domestic mine production constitutes about 20% of Korea's requirement for iron ore. In 1977, Korea imported 3.1 million tons of hematite, mostly from Australia and India, and 0.5 million tons of magnetite, primarily from Peru, Australia, and Mexico. Imports of coking coal totaled 2.0 million tons, supplied mostly by Australia, the United States, and Canada, in that order.

Pohang Iron and Steel Co. (POSCO), with a production capacity of 2.6 million tons of steel per year, dominates Korea's iron and steel industry. The other producers were Dongkuk Steel Mill Co., Inchon Iron Works Co., Kuck Dong Steel Co., and Pusan Iron and Steel Co. Total industry output in 1977 included 2.4 million tons of pig iron and 2.7 million tons of crude steel.

POSCO, the only integrated steel operation in the country, completed its second-stage expansion in May 1976 with the installation of blast furnace No. 2, bringing its crude steel capacity up to 2.6 million tons per year. Posco's facilities include blast furnace No. 1 with a daily capacity of 2,600 tons, blast furnace No. 2 with 3,880 tons, a steelmaking plant with three 100-ton converters, a continuous-casting mill, and hot-rolling and cold-rolling mills. The third-stage expansion program, estimated to cost $1.3 billion, began in October 1976 with the construction of blast furnace No. 3 (loading capacity of 3,795 cubic meters), which would raise POSCO's steel output capacity to 5.5 million tons per year by 1980. A steelmaking mill with two 300-ton converters is also under construction, along with the No. 2 blooming and slabbing mill with five rolling machines, each with a motor capacity of 12,000 kilowatts; and the No. 2 plate mill, which can annually produce 1.4 million tons of plates with a maximum diameter of 4.2 meters and a maximum weight of 25 tons.

A fourth-stage expansion is planned whereby POSCO's crude steel output will reach 8.5 million tons in the 1980's. Construction in the fourth phase includes blast furnace No. 4, a second hot-rolling mill, and the No. 2 continuous-casting mill.

Lead and Zinc.—Young Poong Mining Co., Ltd. (Young Poong) is the largest lead and zinc producer in Korea, operating mines at Yeonhua, Boonpyong, and Ulgen. Young Poong produces all of the country's output of lead concentrate and about 81% of

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the zinc concentrate. Lead metal output, around 6,700 tons, was all by the Changhang smelter of Korea Mining & Smelting Co., Ltd. Young Poong operates a zinc refinery at Sokpo, and output of 1977 was estimated at 32,800 tons. It also exports zinc concentrate to Japan for refining. Korea Zinc Co., which is constructing a 50,000-ton-per-year refinery at Onsan, is owned principally by Young Poong Co. (44.4%), Young Poong Mining Co. (20.5%), and the International Finance Corp. (20.81%). The zinc concentrates being exported to Japan will be treated at the new facility when completed. In addition to zinc, the new facility will have the annual capacity to produce 100,000 tons of sulfuric acid and 300 tons of cadmium metal. The estimated cost of the smelter was $70 million, which included ore storage facilities, a roaster (350 tons per day), and a casting shop. Another 10,000 tons of zinc-refining capacity was expected to be added in 1981.

Tungsten.—Total production of tungsten concentrate, average grade of 0.8%-1.0% WO_3, was estimated at 4,746 tons. The Sangdong mine of Korea Tungsten Mining Co., Ltd., produced the bulk of the country's tungsten. The remainder of the output was distributed as follows, in tons: Chungyang Co., 135; San-Nae mine, 75; Okbang Mining Co., Ltd., 71; Wol-Ak mine, 65; Ssang, 69; Daewha mine, 19; and other, 41. The mill at Sangdong can process 2,000 tons of ore per day; the concentrate produced is shipped to Korea Tungsten's plant at Taegu where it is processed to produce tungsten powder, carbide, and ammonium paratungstate. Production of ammonium paratungstate totaled 2,016 tons; tungsten powder, 645 tons; and tungsten carbide, 189 tons. Korea's production of tungsten constitutes about 60% of the total world output.

Other Metals.—During 1977, 134 tons of bismuth metal was produced as a byproduct of tungsten processing by Korea Tungsten Mining Co., Ltd. Production of silver metal totaled 2.1 million troy ounces. The bulk of the output was by the Changhang smelter of Korea Mining & Smelting and the Boonpyong operations of Young Poong Mining. The country's output of gold metal was 21,380 troy ounces. Close to 65% of the total production was from Korea Mining's Changhang smelter. Output of 40% manganese ore was 664 tons and of molybdenite, 187 tons. Mine production of other metal values during the year included minor amounts of arsenic and tin.

NONMETALS

Cement.—Cement production by 10 plants of 6 companies reached 14 million tons in 1977. Ssangyong Cement Industries Co., Ltd., the largest cement manufacturer, produced about one-third of the country's total output, followed by Tong Yang Cement Co., with about 2.6 million tons; Hanil Cement Manufacturing Co., Ltd., 2.0 million tons; Asia Cement Manufacturing Co., Ltd., 1.4 million tons; and Sung Shin Cement Co., 1.3 million tons. The smaller companies, Hyundai Cement Co. and Korea Cement Co., each produced less than 1 million tons during the year.

Total industry kiln capacity at the end of 1977 was estimated at 16.3 million tons. Under the fourth 5-year plan, domestic production was expected to reach 23 million tons by 1980. Ssangyong Cement was expanding its Tonghae plant from 2.9 million tons to 5.6 million tons. Additionally, Sung Shin Cement began the expansion of its plant at Tanyang to increase capacity from 1 million tons to 2.1 million tons.

During the year, Korea exported close to 1 million tons of cement clinker, primarily to Singapore, Hong Kong, and Bangladesh. Shipments of portland cement totaled 1.8 million tons, with India, Saudi Arabia, Kuwait, and Iran as the principal destinations.

Fertilizer Materials.—Production of urea totaled 1.1 million tons in 1977; compound fertilizers 1.1 million tons; and fused magnesium phosphate, 111,125 tons. Fertilizer manufacturers included Chinhae Chemical Co., Ltd., Han Kook Caprolactan Co., Ltd., Korea General Chemical Corp. (state-owned), Kyunki Chemical Co., Ltd., POSCO, Pungnong Chemical Co., Ltd., and Yong Nam Chemical Co., Ltd. During the year, exports of urea totaled 463,441 tons; fertilizers containing nitrogen, phosphorus, and potassium, 342,326 tons; and fertilizers containing nitrogen and phosphorus, 68,319 tons. The principal destinations were Bangladesh, Pakistan, and the Philippines.

Namhai Chemical Co. started operation of one of two 90-ton-per-day ammonia plants being built at its major fertilizer complex in Yeochem in February 1977. A 1,000-ton-per-day urea plant was to be commissioned shortly afterwards. Other parts of the complex include a 660-ton-per-day phosphoric acid plant, two 1,080-ton-per-day nitrogen-phosphorous-potassium granulated fertilizer plants, two 1,050-ton-per-day sulfuric acid plants, and nitric acid and ammonium nitrate units.

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Other Nonmetals.—Due to greater demand for cement for construction and export, limestone production increased 19% to 22.7 million tons in 1977. Production of kaolin clay was 534,591 tons. Production of talc and pyrophyllite was 171,926 tons and 443,304 tons, respectively. Production of other nonmetallic minerals during 1977 included marine salt, amorphous and crystalline graphite, feldspar, fluorite, diatomaceous earth, asbestos, barite, and andalusite.

MINERAL FUELS

Coal.—Under the Government's energy supply-demand program (1977-81), the average increase in coal production was set at 9.1% annually. The output of anthracite was projected to increase from 21.7 million tons in 1977 to 27.9 million tons in 1981. However, anthracite production was only 17.3 million tons in 1977, a 5% increase over the 1976 output. To encourage growth in coal production, the Government's program called for investing W180.4 billion and $17.6 million in foreign exchange funds in the coal mining industry.

Virtually all of the country's production was domestically consumed, primarily for space heating. The Government-owned DHCC produced 26% of the country's anthracite output. The major mines worked by DHCC are Jang Seong, Do Gye, Ham Baeg, Hwa Sun, and Eun Seong. Total coal reserves in Korea were estimated to be 1.4 billion tons. DHCC holds about 25% ownership of the total reserves; the remainder are in private hands.

Petroleum.—The Republic of Korea imports all of its oil requirements, mostly in the form of crude petroleum, principally from Saudi Arabia. Other suppliers include Iran and Kuwait. In 1977, 22.9 million tons of crude oil was imported, valued at $2.2 billion.

At the end of 1977, South Korea's total oil-refining capacity by three refineries was 435,000 barrels per day. Korea Oil Corp. (KOCO) operates an oil refinery with a daily refining capacity of 215,000 barrels at the Ulsan Petrochemical Industrial Complex. The 60,000-barrel-per-day refinery of Kyong-In Energy Co. is at Inchon. Honam Oil Refinery Co. operates its 160,000-barrel-per-day refinery on the south coast of Yosu.

During 1977, KOCO was continuing an expansion project to increase its daily refining capacity by 65,000 barrels. Work was continuing on the construction of a new 60,000-barrel-per-day refinery at the nonferrous metals industrial complex at Onsan. Construction on this refinery, which is a joint venture between the Ssangyong Business Group and Iranian interests, began in October 1976. Completion of this refinery was scheduled for 1978.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Korean won (W) to U.S. dollars at the rate of W484=US$1.00 for 1977.

[3]U.S. Embassy, Seoul, Korea. State Department Airgram A-155, Sept. 26, 1978.

[4]Economic Planning Board (Seoul, Korea). Monthly Statistics of Korea, v. 20, No. 7, July 25, 1978, p. 165.

[5]Hapdong News Agency (Seoul, Korea). Korea Annual 1978. May 1978, 654 pp.

[6]Ministry of Energy and Resources (Seoul, Korea). Mining Industry in Korea. January 1978, 155 pp.

[7]Economic Planning Board (Seoul, Korea). Major Statistics of Korean Economy 1978. Aug. 22, 1978, 223 pp.

[8]U.S. Embassy, Seoul, Korea. State Department Airgram A-67, Apr. 29, 1978.

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The Mineral Industry of Kuwait

By T. John Rowland, Jr.[1]

In 1977, Kuwait ranked fourth in the Middle East and eighth in the world in terms of petroleum production and third in the world in terms of proven petroleum reserves. Petroleum accounted for nearly 90% of Government revenues, and hydrocarbons (crude and refined petroleum and natural gas) accounted for about 94% of total Kuwaiti exports.

Kuwait, highly developed by regional standards, increased allocations for ordinary budget expenditures from $3.1 billion[2] for fiscal year 1977 to $5.1 billion for fiscal year 1978.[3] The Government undertook a variety of major development projects including expansion of electricity generation and water desalination capacities ($1.2 billion), telecommunications and ports ($750 million), and tanker purchases ($300 million). A draft of the 5-year plan (1977-81) allocated $16.6 billion for development expenditures.

Although the nonfuel industries contributed a very small portion of the 1977 gross domestic product (GDP) of $15 billion, Kuwait was rapidly industrializing with the assistance of the Industrial Bank of Kuwait, which conducted feasibility studies and financed projects. Kuwait's foreign assets surpassed $20 billion in 1977.

The Kuwait-based Arab Fund for Economic and Social Development (AFESD) signed 15 loan agreements for projects in Arab countries totaling $371 million in 1977. The 62% increase over the 1976 loan commitments brought total AFESD loans to nearly $1.06 billion. Egypt, Syria, Jordan, and Lebanon were recipients of significant amounts of Kuwaiti economic aid during 1977.

The Kuwait Oil Co., Ltd. (KOC) awarded Entrepose S.A. (France) a $27 million contract for the improvement of loading facilities at KOC's Sea Island oil export terminal. Scheduled for completion in 1979, the expansion will raise the handling capacity of the Sea Island terminal by 180,000 deadweight tons to a total of 500,000 deadweight tons.

After several months of negotiations, the Government fully nationalized American Independent Oil Co.'s (Aminoil) assets in the Kuwait Saudi Arabia Partitioned Zone by nullifying Aminoil's 29-year-old concession. Kuwait Wafra Oil Co., a new State company, took over the operation, bringing to four the number of State petroleum companies. KOC accounted for 89% of petroleum production and was nationalized by decree in 1975. The other State enterprises were Kuwait Petrochemical Industries Co. (KPIC) and Kuwait National Petroleum Co. (KNPC). KPIC was primarily responsible for petrochemical production, and KNPC controlled over 75% of Kuwaiti refinery capacity. The nationalization of Aminoil affected a modest output involving the company's share of a joint operation with Getty Oil Co. (GOC) at the onshore fields of Wafra and South Umm Gudair.

PRODUCTION AND TRADE

Petroleum production averaged 1.97 million barrels per day in 1977, representing a decline of 8% from that of the previous year. Kuwait lowered its price by 10 cents

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per barrel in September because of large stocks and slow demand. Production from the Partitioned Zone was shared equally between Kuwait and Saudi Arabia. The two-tier price system of the Organization of Petroleum Exporting Countries (OPEC) and large oil stocks resulted in a decline in Arabian Oil Co. (AOC) production. Production in the Partitioned Zone averaged nearly 366,000 barrels per day during 1977.

Gross Natural gas production in 1977 was 363 billion cubic feet, decreasing 8.4% from the 1976 level. Utilization of gas increased 7% over that of 1976. The main improvement in usage was by state enterprises, such as desalination and powerplants, with consumption rising from 108 billion cubic feet in 1976 to 126 billion cubic feet in 1977.

Kuwait's output of refined petroleum products during 1977 averaged 352,300 barrels per day, a decrease of 20.5% from 1976 production. This output represented 58% of the total capacity of Kuwait's three refineries: The KOC refinery at Mina al Ahmadi (285,000 barrels per day), the KNPC refinery at Shuaiba (180,000 barrels per day), and the Kuwait Wafra Oil Co. refinery at Mina Abd Allah (144,000 barrels per day). In addition, Kuwait's share of output from the Partioned Zone averaged 33,200 barrels per day.

Crude oil exports totaled over 554 million barrels, and refined products, including liquefied natural gas, amounted to 118 million barrels in 1977. Crude oil was exported primarily to the Far East (47%) and Europe (38%). Japan remained the major importer of Kuwaiti crude oil, increasing its share to 25% of exports. Other major importers of Kuwaiti crude oil were the United Kingdom, the Netherlands, the Republic of Korea, Italy, and Brazil. Exports of refined products were destined principally for the Far East (71%), but significant amounts also went to Europe (14%) and the Middle East (10%). The United States received about 1% of Kuwaiti refinery exports. Japan was the largest single importer, accounting for 31% of total exports of refined products.

Table 1.—Kuwait: Production of mineral commodities

Commodity and unit of measure	1975	1976	1977[p]
NONMETALS			
Cement—metric tons	172,150	185,727	e200,000
Clay products, nonrefractory: Sand-lime brick—cubic meters	170,477	213,553	e220,000
Fertilizer materials, manufactured, nitrogenous:			
Ammonia, anhydrous—metric tons	r522,743	513,776	e510,000
Ammonium sulfate—do	93,042	NA	NA
Urea—do	554,551	530,591	509,367
Lime, hydrated, and quicklime—do	136	12,301	e15,000
Salt—do	18,057	15,426	e15,000
Sodium and potassium compounds: Caustic soda—do	8,203	6,059	e6,000
Sulfur:			
Elemental, petroleum byproduct—do	60,483	59,486	68,486
Sulfuric acid—do	84,963	4,825	NA
MINERAL FUELS AND RELATED MATERIALS			
Gas, natural:[1]			
Gross—million cubic feet	r382,421	395,805	362,751
Marketed—do	r183,812	196,950	210,510
Natural gas liquids:			
Natural gasoline—thousand 42-gallon barrels	4,532	5,305	NA
Liquefied petroleum gas (propane and butane)—do	12,876	14,543	NA
Total—do	17,408	19,848	e20,000
Petroleum:			
Crude[1]—do	761,634	785,656	718,831
Refinery products:[2]			
Motor gasoline—do	21,128	30,704	6,205
Kerosine—do	r7,992	3,311	3,979
Jet fuel—do	r1,057	4,250	4,088
Distillate fuel oil—do	r23,807	34,382	30,222
Residual fuel oil—do	r58,766	71,096	69,355
Other:			
Naphtha—do	4,383	---	---
Asphalt—do	408	390	375
Unspecified—do	r15,991	18,665	18,773
Refinery fuel and losses—do	r10,419	10,082	8,078
Total—do	r143,951	172,490	140,700

eEstimate. rRevised. NA Not available.

[1]Includes Kuwait's one-half share of production in the Kuwait-Saudi Arabia Partitioned Zone.

[2]Includes Kuwait's one-half share of production by its concessionaires in the Kuwait-Saudi Arabia Partitioned Zone. Data reported in previous editions as including Kuwait's one half share mistakenly excluded that portion.

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Table 2.—Kuwait: Exports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal including alloys, unwrought and semimanufactures	146	283	Saudi Arabia 135.
Copper metal including alloys, unwrought and semimanufactures	18	114	Iraq 61;Saudi Arabia 40.
Iron and steel metal:			
Scrap	18,864	29,351	Iraq 17,380; Pakistan 4,000; Syria 3,881.
Semimanufactures	r75,254	177,111	Mainly to Saudi Arabia.
Lead metal including alloys, unwrought and semimanufactures	218	2,423	Mainly to Saudi Arabia.
Tin metal including alloys, unwrought and semimanufactures	(1)	245	All to Saudi Arabia.
Zinc, blue powder	--	120	Do.
Other:			
Nonferrous metal scrap	4,946	4,849	Iran 1,449; Syria 1,347; Jordan 964.
Metals including alloys, all forms	--	122	Mainly to Saudi Arabia.
NONMETALS			
Abrasives, natural: Grinding and polishing wheels and stones	5	28	Saudi Arabia 18.
Cement	33,443	166,472	Saudi Arabia 153,807.
Clays and clay products (including all refractory brick):			
Crude, bentonite	22,717	31,188	Iraq 26,630; United States 3,280; Saudi Arabia 1,000.
Products:			
Refractory (including nonclay brick)	40	892	Saudi Arabia 510; Bahrain 331.
Nonrefractory	597	3,458	Mainly to Saudi Arabia.
Diamond ---- carats	50	--	
Fertilizer materials:			
Crude	218	120	All to Saudi Arabia.
Manufactured:			
Nitrogenous	653,503	521,009	Sudan 218,840; People's Republic of China, 74,000.
Other, including mixed	5	27	Mainly to Saudi Arabia.
Ammonia	r123,814	177,949	Turkey 83,218; India 26,131; Brazil 14,722.
Gypsum and plaster	20	284	Bahrain 135; Qatar 69; Saudi Arabia 56.
Lime	75	1,314	Mainly to Saudi Arabia.
Salt (excluding brines)	268	2,934	Saudi Arabia 1,267; Lebanon 725.
Sodium and potassium compounds:			
Caustic soda	28,303	4,737	Iraq 3,466.
Soda ash	69	129	Iran 80; Saudi Arabia 47.
Stone, sand and gravel:			
Dimension stone, worked	126	872	Saudi Arabia 765.
Gravel and crushed rock	1,173	1,458	Saudi Arabia 915.
Sand	13,722	2,981	United States 1,967; Qatar 1,000.
Sulfur:			
Elemental, all forms	1,991	92,206	India 86,052; Egypt 2,284; Syria 1,387.
Sulfuric acid	6,141	2,322	Jordan 1,540; United Arab Emirates 607.
Other, crude	50	739	United Arab Emirates 700.
MINERALS FUELS AND RELATED MATERIALS			
Coal and coke, including briquets	--	10	Mainly to Saudi Arabia.
Petroleum:[2]			
Crude ---- thousand 42-gallon barrels	674,634	673,273	NA.
Refinery products:			
Shipments other than bunkers:			
Gasoline ---- do	17,372	27,396	NA.
Kerosine and jet fuel ---- do	6,981	7,950	NA
Distillate fuel oil ---- do	18,865	34,003	NA.
Residual fuel oil ---- do	r32,475	47,238	NA.
Other ---- do	r16,790	13,845	NA.
Total ---- do	r92,483	130,432	
Bunkers:			
Distillate fuel oil ---- do	818	888	NA.
Residual fuel oil ---- do	r14,306	15,441	NA.
Total ---- do	r15,124	16,329	

rRevised. NA Not available.
[1]Revised to none.
[2]Includes Kuwait's one-half share of exports of the Kuwait-Saudi Arabia Partitioned Zone.

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Table 3.—Kuwait: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum metal including alloys, unwrought and semimanufactures	3,192	4,204	Mainly from Turkey.
Copper metal including alloys, unwrought and semimanufactures	506	884	Japan 427; United Kingdom 139; United States 133.
Iron and steel metal:			
Pig iron, ferroalloys, similar materials	191	39	Mainly from Italy.
Semimanufactures:			
Bars, rods, angles, shapes, sections	r188,057	413,062	Japan 209,178.
Universals, plates, sheets	81,064	182,093	Mainly from Japan.
Wire	2,830	5,584	Japan 2,370; People's Republic of China 2,128.
Lead metal including alloys, unwrought and semimanufactures	895	883	United Kingdom 553; West Germany 108.
Nickel metal including alloys, unwrought and semimanufactures	(1)	(1)	All from United Kingdom.
Silver and platinum troy ounces	(1)	5	All from Switzerland.
Tin metal including alloys, unwrought and semimanufactures	10	18	West Germany 12; United Kingdom 5.
Uranium, radium, and thorium and their alloys value	r$5,359	$7,456	United Kingdom $5,424; United States $2,032.
Other:			
Nonferrous metal scrap, not subdivided	1,872	1,243	Saudi Arabia 1,174.
Metals including alloys, unwrought and semimanufactures	409	276	People's Republic of China 120; Belgium-Luxembourg 58; West Germany 35.
NONMETALS			
Abrasives, natural: Grinding and polishing wheels and stones	206	282	Italy 118; Iraq 53.
Asbestos	5,666	3,763	Switzerland 3,659.
Cement	699,116	1,562,070	Japan 1,269,912.
Clays and clay products:			
Crude:			
Earth for cement manufacture	11,537	12,330	All from Saudi Arabia.
Bentonite	38,685	33,882	Ireland 18,288; Greece 14,808.
Products:			
Refractory (including nonclay brick)	785	4,298	United Kingdom 1,826; India 1,011; United States 497.
Nonrefractory	2,683	--	
Diamond, gem, not set or strung carats	3,940	13,570	United Kingdom 8,435; Italy 1,900; Belgium-Luxembourg 1,575.
Fertilizer materials:			
Crude, all types	17	6	All from United Kingdom.
Manufactured, including mixed	228	399	West Germany 181; United States 31; Lebanon 25.
Ammonia	47	6	Mainly from People's Republic of China.
Graphite	19	100	All from Japan.
Gypsum and plaster	15,789	16,859	Egypt 4,366; Iran 3,691; Iraq 2,633.
Lime	5,937	17,085	Japan 6,400; Greece 3,000; Spain 2,500.
Precious and semiprecious stones, except diamond kilograms	146	497	Tunisia 253; Hong Kong 69; India 69.
Salt	4,523	5,310	Saudi Arabia 4,182; Iran 647.
Sodium and potassium compounds:			
Caustic soda	195	62	All from India.
Soda ash	193	70	India 25; People's Republic of China 20; United Kingdom 10.
Stone, sand and gravel:			
Dimension stone:			
Unworked:			
Marble	2,195	2,387	Italy 1,571; Iran 400.
Mosaic stone, pebbles, powder	51,906	81,579	Iran 59,343; Italy 15,070.
Other	3,842	6,049	Syria 3,233; Jordan 2,622.
Worked	18,796	40,398	Italy 15,188; Jordan 12,260; Greece 3,169.
Gravel and crushed stone	574	2,520	Italy 1,620.
Sand	1,552	182	United Kingdom 95; Jordan 50; Syria 19.
Sulfur: Sulfuric acid	97	18	India 13; Netherlands 2; United Kingdom 2.
Other:			
Agricultural soil and clay	158	69	Netherlands 45; Jordan 10.
Unspecified, crude: Chalk, colored soil, clay	1,040	2,012	India 795; Sweden 602.
MINERAL FUELS AND RELATED MATERIALS			
Coal and coke, including briquets	187	807	Iran 315; Japan 300; United Kingdom 115.
Hydrogen, helium, rare gases	65	--	
Petroleum refinery products:[2]			
Aviation gasoline thousand 42-gallon barrels	2	--	
Lubricants do	76	105	NA.
Other do	--	1	NA.
Total do	78	106	

r Revised. NA Not available.
[1] Less than 1/2 unit.
[2] Includes all imports of the Kuwait-Saudi Arabia Partitioned Zone.

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COMMODITY REVIEW

NONMETALS

Cement.—Kuwait Cement Co. (KCC) produced cement from raw materials imported from Iraq. Plant facilities were expanded in 1977 to increase production capacity to 1 million tons per year. KCC entered joint venture arrangements with other Arab countries during 1977. The company reached a preliminary agreement with the Omani Government to produce clinker and cement from local raw materials in Oman. In Saudi Arabia, KCC agreed to construct a cement plant in which it would be a 45% shareholder. Kuwait was to receive 1,000 tons per day of cement and 4,000 tons per day of clinker from the Saudi plant.

Salt.—The salt and chlorine plant owned and operated by KPIC produced the following products during 1977: Chlorine, caustic soda, table salt, hydrochloric acid, sodium hypochlorite, hydrogen, and distilled water. New container equipment for sodium hypochlorite was to improve the competitive stature of the product on local and foreign markets.

MINERAL FUELS

Natural Gas.—By yearend, associated natural gas production totaled 363 billion cubic feet, of which KOC produced 93%. Natural gas was used for reinjection in oilfields, fertilizer production, water distillation, and power generation. Construction continued on the Kuwait Gas Utilization Project, with completion scheduled for 1978. In April, negotiations were begun between the Government and 20 international firms from Japan, the United States, and Europe for marketing the natural gas. The $1 billion project was designed to collect and process high- and low-pressure associated gas from 25 oil-gathering stations located in major Kuwaiti oilfields.

KOC drilled a deep test well to a targeted 20,000 feet in Burgan Field to probe possible hydrocarbon regions underlying the current oil-producing Burgan formation at 4,800 feet. The well was designed to explore the Persian Khuff Zone which has been a major source of non-associated gas in Saudi Arabia, Bahrain, and Iran. AOC was delineating the Dorra Field located north of Hout in the partitioned Neutral Zone which was known to contain large reserves of non-associated natural gas.

Petrochemicals.—KPIC produced ammonia, urea, and sulfuric acid during 1977. Ammonium sulfate was not produced because of the prevailing low prices on the international market. The sulfuric acid unit operated for a period of approximately 4 weeks with output destined for the domestic market, Jordan, and Qatar. Production of liquid ammonia decreased 1%, and urea production increased 4% in 1977. The results of a feasibility study were favorable for construction of a 1,000-ton-per-day ammonia plant at the port of Shuaiba. The new plant would increase ammonia production capacity at Shuaiba to 3,000 tons per day. Associated gas from area oilfields would supply raw materials for the plant. The plant's output was destined for export. KPIC increased urea production capacity to 2,500 tons per year in early 1977. Work continued on construction of an extraction unit for dissolved urea and ammonia in the waste water of the urea plant. Completion of the project was expected during 1978.

In July, the Government approved a $40 million contract for construction of a synthetic rubber plant. With a design capacity of 42,000 tons per year, the plant was initially to use imported feedstock and later obtain material from local sources. The bulk of synthetic rubber production was to be exported, with a small amount destined for domestic tire production. Foster Wheeler Italiana S.P.A. was awarded a $12 million contract by KOC to construct a 200,000-ton-per-year asphalt plant. No completion date was announced, but output will be utilized for road construction.

A final decision as to the implementation of Kuwait's $900 million aromatics project was to be decided by KPIC. After the withdrawal of the original partner in the venture, W. R. Grace & Co. (United States), Kuwait invited Saudi Arabia, Qatar, Bahrain, the United Arab Emirates, and Oman to participate in the project. Only Bahrain expressed an interest in the Kuwaiti proposal. Annual production was to consist of benzene (284,000 tons), paraxylene (87,000 tons), and orthoxylene (60,000 tons) from feedstock of 1.3 million tons per year of straight-run naphtha produced in Kuwait.

Petroleum.—Crude oil reserves of Kuwait were estimated at 72 billion barrels at yearend. Reserves are calculated to last 70

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to 85 years at the proposed production rate of 2 million barrels per day. Reserve estimates were based on data from the following producing fields: Kuwait-Burgan, Magawa, Ahmadi, Umm Gudair, Minagish, Raudhatain, Sabriyah, and Bahrah and Partitioned Zone-Walfin, South Umm Gudair, and South Fawares (onshore) and Khafji and Hout (offshore).

A new source of oil in northern Kuwait was confirmed by the completion of an exploratory well on April 30. Three additional wells were completed in the area, and drilling was proceeding on the fifth well. KOC production facilities were also under construction in the area. A deep seismic survey was planned for the Magawa-Ahmadi field area. Information derived from the survey was to be used to locate deep wells for KOC's continuing exploration program. Geological mapping of reservoirs resulted in improved interpretation of oil reservoirs and their fluid distributions. Reservoir studies based on these data have recently been completed for the Raudhatain and Burgan fields.

Production in the Partitioned Zone was shared equally by Kuwait and Saudi Arabia. AOC, the offshore concession holder, was composed of a Japanese consortium and the Governments of Kuwait and Saudi Arabia. Two oilfields accounted for the production, Hout and Khafji. The Khafji field was an extension of the Saudi Safaniya field, the largest known offshore deposit in the world.

Onshore operations in the Partitioned Zone were conducted by Aminoil (representing Kuwait) and GOC (representing Saudi Arabia). In 1977, Aminoil's concession, granted in 1948, was cancelled; all production facilities and the 144,000-barrel-per-day refinery were assumed by the newly established Government firm Kuwait Wafra Oil Co. Offshore crude oil reserves at the beginning of 1977 were estimated at 5.38 billion barrels. Reserves of the Aminoil-Getty onshore concession were estimated at 962 million barrels.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Kuwaiti dinars (KD) to U.S. dollars at the rate of KD1=US$3.4487.

[3]Kuwait's fiscal year is the year ending June 30 of that stated.

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The Mineral Industry of Liberia

By Janice L. W. Jolly[1]

Liberia's 1977 mineral production consisted of iron ore, diamond, gold, cement, and refined petroleum. The contribution of the mineral export value to the nation's gross domestic product (GDP) of $697.7 million[2 3] (at current prices) was 43% in 1977. Real GDP growth was -1.6%, based on 1971 constant prices. Production of iron ore declined for the second year as world steel markets remained depressed. Liberia's first iron ore mine at Bomi Hills closed in March. The petroleum refinery remained inoperative throughout most of 1977 after the destructive fire of late 1976, and most refined petroleum needs were supplied by imports. Reversing a trend since 1973, diamond production increased in 1977, up 29% in value over that of 1976.

A new mineral policy was under study.[4] A preliminary consideration was the creation of a State mining corporation and the framework under which the Government might participate in mineral exploitation. Other considerations included direct Government participation in marketing and mineral transportation, provision for a diversified vertical integration of mineral development, a program for exploration and mineral mapping, and a program for the development of a potential petroleum industry.

The Liberian Government was requesting United Nations assistance in evaluating the gold and other mineral potential east of the Cestos River. A complete mineral survey of the area was expected to cost $3.5 million over a 3-year period. The Liberian Geological Survey also continued its mineral evaluation program in Grand Cape Mount, Grand Gedeh, Lofa, Montserrado, and Sinoe Counties, along with its participation in the phasing out operations of the Liberia Mining Co., Ltd. (LMC) concessions. Copper and lead anomalies were to be further evaluated in the Bopolu Quadrangle.

A mine inspection team was organized by the Liberian Ministry of Lands and Mines for the purpose of making regular inspections of mining concessions to ensure good mining practices, safety procedures, and preservation of the environment. The team made its first inspection at the Bong mine in December.

Under the Mano River Union agreement, Liberia and neighboring Sierra Leone were promoting economic cooperation for accelerated development. Although a full customs union was not yet in effect, progress was made toward that goal when, on November 10, Liberia implemented partially harmonized tariffs under the agreement. The initial effect of the harmonization was a rise in cost of certain imports, which was expected to contribute to increased inflation over the long term.

PRODUCTION AND TRADE

Liberia's export earnings, valued at $447.5 million in 1977, were dependent upon two principal mineral commodities— iron ore (74%) and diamond (4%). Gold was produced as a byproduct of diamond mining as well as by small-workers in alluvial diggings, but no official export or production figures were available. Total imports for 1977 were valued at $464 million.

Not only did Liberia's iron ore exports

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decline in 1977, but the proceeds earned were further eroded by the progressive depreciation of the U.S. dollar. The three operating companies were producing at only 72% of the rated annual operating capacity of about 24 million tons. Iron product exports of 17.4 million tons were valued at $296.8 million for 1977, compared with 20.5 million tons valued at $331.6 million for 1976.

Liberian American-Swedish Minerals Co.-Joint Venture (LAMCO-JV) exported 8.2 million tons of iron ore in 1977, compared with 9.3 million tons in 1976. This included 774,000 tons of pellets in 1977 compared with 1,449,000 tons of pellets in 1976. Much of the ore is supplied under long-term contracts to a number of steelworks in Europe and Japan, and some of it is carried by agreement in ships owned by Gränges AB (Sweden). Malmexport AB of Sweden is the sales agent.

Bong Mining Co. (BMC) produced 15.2 million tons of crude ore, 4 million tons of concentrate, and 2.4 million tons of pellets during 1977. BMC exported 6 million tons of iron ore products, including 3.7 million tons of concentrate (sinter feed) valued at $50,800 and 2.4 million tons of pellets valued at $73,300. The 1976 shipments were 6.4 million tons, by comparison. Rohstoffhandel G.m.b.H., representing several West German steel producers, imported 2.8 million tons of concentrate and 1.4 million tons of pellets, and the Italian company Italsider S.p.A. imported 904,000 tons of concentrate and 959,000 tons of pellets. Because of lower prices and a softening of the European market, export sales were expected to be less in 1978 than in 1977.

March 31 was the final closing date for LMC's mining operations at the Bomi Hill's mine. During its last year, LMC's production totaled 386,400 tons including 150,200 tons of blast furnace ore, 118,200 tons of fines, and 118,000 tons of concentrate. Exports totaled 592,600 tons, including 201,500 tons of blast furnace ore, 201,100 tons of fines, and 190,000 tons of concentrate.

National Iron Ore Co. Ltd. (NIOC) mined 5.2 million tons of ore in 1977 and exported a total of 2,749,000 tons of blast furnace feed and fines. This compares with 2,755,000 tons exported in 1976. Shipments were made to several European steel corporations under long-term contract. Caemi International of the Netherlands was the sales agent for iron ore produced at the Mano River mine.

The value of Liberian diamond exports increased to $21.6 million in 1977 from $16.6 million in 1976 and $17.8 million in 1975. With the improvement in the world market, diamond exports were expected to maintain the upturn through 1978. Diamond production was 326,000 carats in 1977.

Table 1.—Liberia: Production of mineral commodities

Commodity[1] and unit of measure	1975	1976	1977[p]
METALS			
Gold[e] — troy ounces	[r]4,500	[r]4,500	4,500
Iron ore — thousand tons	[e]24,000	18,814	18,136
NONMETALS			
Cement, hydraulic — do.	90	[e]100	[e]100
Diamond:			
Gem — thousand carats	221	148	163
Industrial — do.	185	172	163
Total — do.	406	320	326
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline — thousand 42-gallon barrels	549	326	NA
Kerosine — do.	75	79	
Jet fuel — do.	282	258	
Distillate fuel oil — do.	1,253	1,309	
Residual fuel oil — do.	1,555	1,498	
Other — do.	30	21	
Refinery fuel and losses — do.	218	208	
Total — do.	3,962	3,699	NA

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, a variety of crude construction materials (clays, stone, and sand and gravel) were produced, but available information is inadequate to make reliable estimates of output levels.

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Table 2.—Liberia: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal including alloys, all forms	--	2	All to Sierra Leone.
Iron and steel:			
Ore and concentrate thousand tons	18,401	20,533	West Germany 6,713; Italy 3,407; France 2,025.
Metal:			
Scrap	--	448	All to Norway.
Semimanufactures	19	13	Mainly to Ghana.
NONMETALS			
Cement	654	(1)	All to Sierra Leone.
Diamond, gem and industrial carats	420,014	320,298	Belgium-Luxembourg 168,232; United Kingdom 97,278.
Fertilizer, manufactured, nitrogenous	--	19	All to Togo.
Salt	10	--	
Sodium compounds: Caustic soda	--	1	All to Sierra Leone.
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	11,173	10,972	All to Guinea.
Kerosine do	31	--	
Lubricants value	$12,673	$12,037	Mainly to Sierra Leone.
Nonlubricating oil do	$3,937	$36	All to Sierra Leone.

[1]Less than 1/2 unit.

Table 3.—Liberia: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum:		
Oxide and hydroxide	282	(1)
Metal including alloys, all forms	474	441
Arsenic trioxide, pentoxide, acid	10	--
Chromium oxide and hydroxide	1	2
Copper metal including alloys, all forms	35	40
Iron and steel metal:		
Scrap	--	706
Pig iron, ferroalloys, similar materials	1,645	20
Steel, primary forms	198	297
Semimanufactures:		
Bars, rods, angles, shapes, sections	3,610	3,817
Universals, plates, sheets	4,318	5,625
Hoop and strip	19	30
Rails and accessories	2,241	3,537
Wire	44	101
Tubes, pipes, fittings	r1,963	2,488
Castings and forgings, rough	1,388	215
Lead metal including alloys, all forms	54	79
Mercury 76-pound flasks	3	--
Nickel metal including alloys, all forms	8	1
Platinum-group metals and silver:		
Ores and concentrates value	--	$106
Metals including alloys:		
Platinum-group troy ounces	--	1
Silver do	--	105
Tin:		
Oxide	--	1
Metal including alloys, all forms	11	3
Zinc metal including alloys, all forms	9	184
Other:		
Ores and concentrates of nonferrous base metals value	$951	$136
Nonferrous metal scrap do	$1,140	$1,020
Oxides, hydroxides, peroxides of metals	1	14
Metals including alloys, all forms:		
Metalloids	(1)	13
Alkali, alkaline-earth, and rare-earth metals, n.e.s.	1	7
NONMETALS		
Abrasives, natural, n.e.s.:		
Grinding and polishing wheels and stones	86	324
Other value	--	$207,599
Asbestos	15	77
Boron materials, oxide and acid	100	34

See footnotes at end of table.

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Table 3.—Liberia: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS —Continued			
Cement		53,377	23,578
Clays and clay products (including all refractory brick):			
Crude		23,550	16,393
Products:			
Refractory (including nonclay brick)[2]		284	156
Nonrefractory[3]		725	839
Fertilizer materials:			
Natural:			
Nitrogenous		6,429	5,197
Phosphatic		r352	77
Manufactured:			
Nitrogenous		14,163	20,497
Phosphatic		592	532
Potassic		468	1,847
Other, including mixed		565	61
Ammonia		1,661	1,233
Graphite, natural		---	96
Gypsum and plaster		1,008	2,955
Lime		1,480	1,402
Magnesite		1	2
Mica, worked		(1)	(1)
Precious and semiprecious stones, not set or strung	value	---	$859
Salt		2,998	4,148
Sodium and potassium compounds, n.e.s.:			
Caustic soda		1,320	1,358
Caustic potash and sodic and potassic peroxides		7	203
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked		653	804
Worked	value	$39,431	$19,472
Dolomite, chiefly refractory grade		44,639	50,248
Gravel and crushed rock		r33,210	49,103
Sand, excluding metal bearing		r1,925	907
Sulfur:			
Elemental (including unroasted pyrites)		7	2
Sulfuric acid		113	599
Other:			
Crude	value	r$783	$6,410
Oxides and hydroxides of magnesium, strontium, barium		1	25
Bromine, iodine, fluorine		(1)	9
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		36	21
Carbon black		1	3
Coal and coke, including briquets		5,570	16,133
Hydrogen and other rare gases	value	$17,075	$831
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	3,788	4,145
Refinery products:			
Gasoline	do	4	26
Kerosine and jet fuel	do	(1)	3
Distillate fuel oil	do	(1)	(1)
Residual fuel oil	do	(1)	---
Lubricants[4]	do	77	114
Mineral jelly and wax	do	(1)	1
Other:			
Liquefied petroleum gas	value	$8,356	$12,266
Nonlubricating oils, n.e.s.	do	$104,744	$88,581
Other	do	$91,815	$385,600
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		36	134

rRevised.
[1]Less than 1/2 unit.
[2]Excludes quantities valued at $58,390 in 1975 and $158,079 in 1976.
[3]Excludes quantities valued at $115,330 in 1975 and $14,186 in 1976.
[4]Excludes quantities valued at $15,170 in 1975 and $30,482 in 1976.

COMMODITY REVIEW

METALS

Copper.—The Geological Survey of Liberia was investigating two copper anomalies in the Taju Hill area. The northern zone was 6 meters wide over a distance of 1 kilometer, and the other occurred south of an area of chalcopyrite-bearing syenites. Near-surface phosphate concretions with copper and zinc were also reported. Mueller

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Co. prospected this area, drilling one diamond drillhole at the northern anomaly.

Gold.—Interest in gold mining, supported by an effort of the Ministry of Lands and Mines to locate and quantify gold-bearing areas, continued to increase. Although total gold sales by Globex Minerals (Liberia) Ltd. were reported at 52.5 troy ounces valued at $4,700 in 1976 and 24.06 troy ounces valued at $2,960 in 1977, no firm overall gold production figures were available for either 1976 or 1977. All gold recovered was sold at the mining sites to jewelers or other interested buyers, many of whom were suspected of taking the gold to neighboring countries for higher prices.[5]

African Mining Partners and Azuza Mining Corp. ceased operations, but approval was granted to Preussag Metall AG to continue gold exploration associated with base metal sulfides. Trico Mining Co., with Liberian and U.S. backing, was negotiating for a gold and diamond concession in a 187,266-acre area of Grand Cape Mount County. Liberia Colorado Mining Co. (25% Liberian interests) was incorporated as a Liberian corporation in June and applied for a 128,000-acre concession in Montserrado. Carbon Mining Co. held a gold and diamond concession in Grand Cape Mount and Lofa Counties.

Heavy Minerals.—Testing of a 20-ton bulk sample shipped to Australia in 1975 was completed in 1976 by Liberia Beach Sands Exploitation Co. (LIBSEC), a Dutch syndicate, under a 25-year concession to exploit the heavy minerals between the Cestos and Cavalla Rivers. The completed test and feasibility studies were considered favorable for commercial production of rutile, zircon, ilmenite, and monazite. Problems to be overcome included the construction of all-weather roads to the separation plant that will be constructed at Greenville. The initial investigation disclosed reserves of 700,000 tons containing an average of 40% heavy minerals, including 192,000 tons of ilmenite, 33,000 tons of zircon, 12,000 tons of rutile, and 4,000 tons of monazite. Large areas of yellow, unconsolidated beach sand with a 50% heavy mineral concentration occur at depths of 6 to 9 meters as well as at the sediment surface.

The Geological Survey of Liberia continued a systematic laboratory examination of heavy mineral concentrates that was started as part of the Geological Exploration and Resources Appraisal (GERA) project conducted by the Liberian and U.S. Geological Surveys to serve as the guide for mineral exploration. The majority of samples were collected from the Gondoja area, Grand Cape Mount County; Kumgbor Area, Lofa County; and Kanweaken Area, Grand Gedeh County. The following economically significant minerals were identified: Columbite-tantalite, scheelite, chromium spinel, lead, zinc, copper and iron sulfides, gold, and magnesian ilmenite and pyrope garnet, both significant diamond (kimberlite) indicators.

A deposit of rutile, associated with ilmenite and hematite, was discovered in New Cess Area, Grand Bassa County. The Liberian Geological Survey was to make an investigation of the economic viability of this deposit.

Iron Ore.—The average price for Liberian iron ore improved slightly at yearend, but the increase was not enough to compensate for a simultaneous 9% increase in operating costs. The Liberian Government was seriously considering taking a more agressive role in iron ore marketing as a result of Brazilian ore competition and the depressed market. Liberia became a member of the Association of Iron Ore Exporting Countries (AIOEC) on January 15, 1977.

The Republic of Liberia owns 50% of LAMCO's shares, and the remaining 50% belongs to a Canadian-registered corporation, Liberian Iron Ore Ltd. (LIO). The largest stockholder in LIO is the Swedish LAMCO Syndicate, which owns 74.8% of the shares. The largest participant of the Syndicate is Gränges AB. LAMCO-JV was brought into being in 1960 by an agreement between LAMCO and Bethlehem Steel Corp. At the beginning of 1977, LAMCO-JV's assets were valued at $300 million, of which 75% was furnished by LAMCO. Gränges International Mining has the responsibility for running the operations through a subsidiary called LAMCO-JV Operating Co. About 4,000 persons are employed, of which 500 are Europeans. The ore is sold through Malmexport AB, a sales organization run partly by Gränges.

The LAMCO operation included open pit mines at the Nimba main ore body near Yekepa and at Mt. Tokadeh, an iron ore processing complex at Buchanan on the Atlantic Ocean, and a 273-kilometer connecting railroad. The high-grade Nimba itabirite deposits are located along the horse-shoe-shaped Nimba-Gbahm range. The largest deposit was the main ore body at Nimba, which was estimated to contain

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150 million tons of blue hematite ore. Tokadeh and the surrounding mountains were estimated to contain 500 million tons of ore grading 40% to 55% iron. The 13.5 million tons of crude ore normally supplied by the mines each year was to yield 12.4 million tons of finished products after ore treatment at Buchanan and was to consist of 2.2 million tons of pellets, 10 million tons of fines, and 0.2 million tons of run-of-mill ore. In addition, a lumpy grade was to be produced on demand. The run-of-mine grade would contain between 6% and 22% silica.

LAMCO-JV was in the process of implementing the results of major research that involved development of a new pellet preparation process. The investment required was estimated at $12 million for the process which involved installation of wet, high-intensity magnetic separators instead of reversed flotation for upgrading of the finest Nimba ore fractions into pellet feed. The new process was to eliminate many of the operation problems caused by the heterogeneity of the ore body.[6] One of the problems was the expected sharp increase in silica content of the Gbahm ore in the classifier overflow, predicted after 1979.

During 1977, BMC completed its second pellet plant. The new facilities expanded production capacity to a total of 7.5 million tons, including 4.8 million tons of pellets and 2.7 million tons of sinter feed. The second grate-kiln pellet plant started up November 28, with an annual capacity of 2.4 million tons. An 11th line was added to the concentrator, and a concentrate blending system and flotation plant for pellet feed recovery were also included as part of the new facilities. The pellet feed was blended by the system from two stockpiles, each able to feed the plant for a week. The finely ground product passes through the new flotation plant where the silica is removed. Three new 9-megawatt generators were added during 1977, increasing installed electrical capacity from 68 megawatts to 95 megawatts.

LMC ceased mining operations in March. It was Liberia's first iron ore producer, and in its almost 26 years of mining activity, about 46 million tons of iron ore was produced from the Bomi Hills mine. The Liberian Geological Survey completed a study and estimation of the ore remaining at Bomi Hills. A feasibility study for reactivation of mining was also completed by the Liberian Bureau of Mines. It was estimated that 1.8 million tons of direct-shipping ore (66% iron), 43 million tons of 40% iron, and 20 million tons of other ore were dumped near the main pit area, and that the mine might be able to operate economically for another 4 to 6 years. Negotiations were proceeding between the Government and LMC to determine ownership of the assets at Bomi Hills.

To improve recovery, NIOC planned modification to the ore mill in 1978 and 1979; the cost was estimated at $1 million. Total operating costs for 1977 were $16.1 million, 57.4% of which was for materials and supplies. No additions to productive capacity were made in 1977, and output was adversely affected at Mano River by a record high rainfall. In addition to the takeover of the LMC railroad, NIOC was also required to operate the LMC water system and powerplant, pending the final takeover by the Government.

Mifergui-Nimba Co. (owned 50% by the Guinea Government and 50% by other interests including the Governments of Liberia, Nigeria, and Libya; Sonarem of Algeria; Nichimen Co., Ltd., of Japan; Instituto Nacional de Industria, Cia. Minera de Sierra Menara, and Cofei of Spain; Mineralimportexport of Romania; and Solmer and Usinor of France) had not yet settled the question of how much LAMCO was to charge for transporting the Mifergui ore from Guinea's iron ore deposits at Mount Nimba. Following a basic agreement in 1976, LAMCO had started negotiations in 1977 for a more definitive contract to carry out its transportation obligations. About $100 million would be needed to construct the rail extension from Nimba to Mifergui, buy rolling stock to carry the ore, build additional rail sidings, and undertake expansion of rail terminal and port facilities at Buchanan. It was estimated that Mifergui ore would be exported through the port of Buchanan beginning sometime in 1982.

Disputes during 1977 over European participation in the Wologisi iron ore project were casting doubts on the future of the project and progress toward eventual exploitation. Liberian International American Corp. (LIAC), the parent company of Liberia Iron and Steel Co. (LISCO), had worked out a plan to speed up exploitation, but several participants voted against it. This left intact the plan to develop a 10-million-ton-per-year pellet plant.

Tungsten.—Two geological teams of the Liberian Geological Survey continued field investigations of the scheelite minerali-

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zation in the Gondoja area. Examination indicated a possible extension to the Sam Davis Creek pegmatite that contains scheelite. Associated minerals were rutile, base metal sulfides, magnetite, apatite, quartz, and sericite.

Uranium.—Western Enterprises Inc., a subsidiary of Coastal States Gas Corp. of Houston, Tex., was granted a uranium mining concession. The agreement covers an area of 25,000 square miles in Sinoe, Grand Gedeh, Nimba, and Lofa Counties and in Bomi Territory. Under the agreement, the company was to assign all obligations and rights to a Liberian corporation, CLU Enterprises Inc., in which 25% of the shares was to be reserved for offer to Liberian citizens. CLU was to be exempt from income tax for 5 years and also from import duties for equipment and supplies for a limited period. CLU will pay a royalty of 4% on all uranium produced and sold and a royalty ranging from 4% to 6% on all other minerals produced. In addition, the company was to pay rentals of $2.50 to $10.00 per square mile for land included in the exploration area and was obligated to spend $3.75 million over a period of 5 years. Exploration was to begin in the Nimba area.[7]

Airborne radiometric surveys by the U.S. Geological Survey indentified a number of favorable anomalies. The best target areas for future uranium exploration were describod as along the edges of iron formations.

NONMETALS

Barite.—Barite reserves at Gibi were estimated at approximately 1 million tons; further drilling would be required for more accurate estimates. Lofa Construction Co. applied for additional exploration time in 1976. Senwein Mining Corp. also applied for exploration rights at Gibi.

Cement.—Cement was produced by Liberia Cement Corp. of Bushrod Island, Monrovia. The brand name is Blue Star cement, which is a finished portland cement (105 ASTM C-150). A total of 108 persons were employed by the plant.

Chrysoberyl.—A commodity report entitled "Chrysoberyl in Liberia" was completed and released as Liberian Geological Survey report MR-83. Chrysoberyl has been reported in panned concentrates from gravels of the Lofa River basin. This study reported on the economic potential and occurrences of this mineral.

Diamond.—Globex had a diamond concession on the Lofa River in the alluvial deposits. Diamond sold by Globex in 1977 totaled 213 carats valued at $12,507. During 1977, Globex worked two areas, Jawajai and Gbene on the Lofa River. Exploration was being carried out between Jawajai and Go Home. West Africa Consultants was surveying Globex concession boundaries. Kimberlite pipes at Kano Godua were reportedly not diamond bearing, but further testing was recommended. The Diamond Appraisal Office continued to be operated by Diamond Corp. of West Africa, a subsidiary of De Beers Consolidated Mines Ltd. of London. A second Liberian trainee was sent to London for a 2-year course in diamond appraising.

Fertilizer.—Fertilizer use was actively encouraged by the Liberian Government, and demand was increasing. Fertilizer consumption was about 10,000 to 15,000 tons per year. A fertilizer plant was under consideration.

Stone, Crushed.—Efforts were made to increase crushed rock output from the Noway quarry at Mano River. Production in 1977 was 32,000 tons compared with 2,900 tons in 1976. The rock was used to upgrade mine haulage roads by NIOC.

MINERAL FUELS

Petroleum.—Negotiations for the purchase and takeover of the Liberia Refining Corp. (LRC) 15,000-barrel-per-day refinery at Monrovia continued throughout the year. Claims of expropriations[8] were being made by LRC after difficulties in negotiations with the Liberian Government occurred. The Government denied these charges, and by yearend, negotiations had resumed. LRC was owned 67% by Sun Trading and Marine Transport Inc., 18% by Dynalectron Corp., and 15% by Liberian interests, including 1.9% by the True Whig Party.

The Liberian Government was considering starting a detailed investigation of onshore and offshore areas for petroleum. The Romanian Government had indicated an interest in reinterpreting previous seismic data collected and doing geological and geophysical surveys of the Roberts and Bassa Basins. The Romanian company ROMPETROL submitted a proposal for a $3 million hydrocarbon exploration project.

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[1]Physical scientist, Branch of Foreign Data.
[2]Liberia uses U.S. dollar currency.
[3]U.S. Embassy, Monrovia, Liberia. Revised GDP, State Department Airgram A-16, Apr. 19, 1978, 6 pp.
[4]Ministry of Lands and Mines. Annual Report for the Period Jan. 1, 1977, to Dec. 31, 1977. P. 14.
[5]Ministry of Lands and Mines. Annual Report for the

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Period Jan. 1, 1976, to Dec. 31, 1976. P. 31.
[6]LAMCO Newsletter (Stockholm). Nimba Pellets—A Decade of Development Work. No. 8, April 1977. 21 pp.
[7]U.S. Embassy, Monrovia, Liberia. State Department Airgram A-65, Dec. 29, 1977, 2 pp.
[8]Wall Street Journal. Liberia Seizes Stake Held by Dynalectron and Sun Co. May 16, 1977, P. 6.

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The Mineral Industry of Libya

By T. John Rowland, Jr.[1]

Petroleum and natural gas continued as Libya's most important mineral commodities during 1977. Libya possessed 4.7% of the world's crude oil reserves at yearend and accounted for 3.5% of 1977 world production. Libyan exports for 1977 were valued at $10.5 billion,[2] of which 99% was contributed by petroleum revenues.

In October, National Oil Corp. (NOC) announced its plans for future Libyan oil production. Under the current 5-year plan (1976-80), Libya plans to produce an average of 2.4 million barrels per day in 1978 and 2.7 million barrels per day by 1980. The future production rates were scheduled with consideration for the development of new fields, production declines at some existing fields, conservation regulations, and economic factors.

Czechoslovakia and Libya signed a trade agreement in June under which Libya was to export oil to Czechoslovakia in exchange for tractors, agricultural equipment, compressors, metallurgical products, and clothing.

The U.S.S.R. contracted for the construction of a 440-megawatt nuclear powerplant in Libya. Under the terms of the contract, the U.S.S.R. will construct the plant and Finland will design and construct the emergency cooling system. The plant will be Libya's second nuclear reactor and its first commercial nuclear powerplant.

A $445 million contract was let to a West German company to build a steam power station 78 miles east of Tripoli at Homs. The station will generate electricity and desalinate 40,000 cubic meters of seawater per day. The project, to be completed by 1980, includes a 220-kilovolt transformer station, warehouse, workshop, and port.

Libya's roadbuilding program progressed during 1977. Epiritoki Co. of Greece was awarded a contract for $423 million to construct a total of 435 miles of roads on two north-south, trans-Saharan routes. The longer route will provide a 603-kilometer link between Jalo and Kufra in the eastern part of Libya; in western Libya, a 97-kilometer road will extend from Ghariar to Brak.

PRODUCTION AND TRADE

Libyan crude oil production totaled 753 million barrels during 1977, compared with 707 million barrels in 1976. Producing oil wells numbered 1,030 at yearend 1977, an increase of 55 over those of yearend 1976. Libyan oil production remained the second largest in Africa, closely following that of Nigeria. Cement production increased as a result of the opening of new plants. Other mineral production included small amounts of brick, gypsum, lime, sand and gravel, and crushed and dimension stone.

Crude oil and natural gas dominated Libya's mineral exports in 1977. Exports of crude oil increased 12.3% during the first half of 1977 to nearly 2 million barrels per day. Western Europe's share of Libyan crude oil exports declined from 55% in 1976 to 47% in 1977, while that of the United States increased from 27% to 40%. Exports to Japan decreased 59% in 1977.

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Table 1.—Libya: Production of mineral commodities

Commodity[1] and unit of measure	1975	1976	1977[p]
NONMETALS			
Cement, hydraulic thousand metric tons	830	1,500	2,500
Gypsum do.	[e]50	60	290
Lime do.	14	325	1,000
Salt[e] do.	10	10	10
MINERAL FUELS AND RELATED MATERIALS			
Gas, natural:			
Gross million cubic feet	[r]489,042	633,798	706,582
Marketed[2] do.	[r]382,638	486,605	556,247
Petroleum:			
Crude thousand 42-gallon barrels	540,129	707,336	753,129
Refinery products:			
Gasoline do.	1,314	2,372	2,409
Kerosine and jet fuel do.	2,956	2,701	9,672
Distillate fuel oil do.	3,322	6,460	9,016
Residual fuel oil do.	5,548	6,935	13,067
Other do.	584	146	219
Refinery fuel and losses do.	(3)	147	1,387
Total do.	13,724	18,761	35,770

[e]Estimate. [p]Preliminary. [r]Revised.

[1]In addition to the commodities listed, a variety of construction materials (sand and gravel, crushed stone, brick, and tile) are also produced, but available information is inadequate to make reliable estimates of output levels. Natural gas liquids are also produced but are blended with crude petroleum and are reported as part of that total.

[2]Includes gas reinjected into reservoirs, if any.

[3]Revised to none.

Table 2.—Libya: Exports of crude oil, by destination

(Thousand 42-gallon barrels)

Country	1975	1976	1977
Austria	1,022	4,795	621
Bahamas	26,244	11,566	15,659
Belgium-Luxembourg	2,044	1,903	840
Brazil	15,951	11,932	10,257
Bulgaria	840	1,610	2,154
Canada	4,198	4,575	NA
Denmark	840	146	NA
France	19,601	35,685	28,470
Germany, Federal Republic of	103,952	136,006	120,998
Italy	107,347	126,124	115,012
Japan	17,338	13,469	5,585
Netherlands	10,549	16,397	13,797
Romania	6,315	12,481	6,424
Spain	23,543	34,770	38,435
Switzerland	2,373	2,745	767
Trinidad and Tobago	4,818	NA	NA
United Kingdom	18,396	15,299	13,323
United States	116,581	181,573	287,000
Unspecified	40,436	64,780	49,853
Total	522,388	675,856	709,195

NA Not available.

Source: Organization of Petroleum Exporting Countries. Annual Statistical Bulletin 1977.

COMMODITY REVIEW

Cement.—Cement production in 1977 totaled 2.5 million tons, a substantial increase over the 95,000 tons in 1970. During 1977, the production capacities of the cement factories at Benghazi and Homs were increased to 1 million tons and 440,000 tons per year, respectively. In June, a 1-million-ton-per-year plant was opened at Suk el Khamis to supply the building requirements of Tripoli. Construction of another 1-million-ton-per-year plant at Benghazi was near completion, with production scheduled for early 1978. Libya reached 90% self-sufficiency in cement production in 1977.

Gypsum and Salt.—A $3 million contract was signed with an unidentified firm to provide consulting services for a large chemical complex at Marada. Annual production capacity is to be 30,000 tons of magnesium, 27,000 tons of sodium chloride,

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19,000 tons of potassium chloride, and 8,000 tons of gypsum.

Iron and Steel.—Dastur International of India completed a feasibility study for an iron and steel complex at Misurata, located 200 kilometers east of Tripoli. The first phase of the plant was scheduled for completion in 1980 with an annual capacity of 1 million tons of steel. The direct-reduction-process unit was to be fueled by domestic natural gas. The Wadi Shati iron ore deposit, with estimated reserves of 2 billion tons, will be mined to supply the ore. Other facilities included a steel-melt shop, casting plant, bar and rod mill, light- and medium-section mill, semicontinuous hot strip mill, and cold-rolling mill.

Natural Gas.—Libya's natural gas reserves, estimated at 28,500 billion cubic feet at yearend, were the third largest in Africa, exceeded only by those of Algeria and Nigeria.

Elf-Aquitaine (France) discovered a large natural gas deposit in the Zuara offshore concession west of Tripoli. Commercial evaluation of the deposit was to be undertaken in early 1978. By yearend 1977, a 272,000-ton-per-year nitrogen ammonia plant at Marsa el Brega was to be completed, with production scheduled for early 1978. The plant was designed and constructed by Friedrich Uhde GmbH of the Federal Republic of Germany. The output of the plant will be exported until a urea production unit is completed.

A gas-gathering system was planned to supply feedstock and fuel for the Marsa el Brega liquefied natural gas plant and petrochemical complex. The system was also to distribute natural gas to the projected steel complex at Misurata.

Petroleum.—Libyan crude oil reserves, the largest in Africa, were estimated at over 25.3 billion barrels, an increase of 3.4% over the 1976 level.

Eight groups of companies operated in Libya in 1977 under production-sharing agreements with the Government. The most active firms were Occidental of Libya Inc. (Oxylibya) and Oasis Oil Co. of Libya.

Three new fields in the southwestern section of the Sirte basin were to be developed by Oxylibya. The project was expected to contribute an additional 75,000 barrels per day to Sirte basin production. Under the production agreement, ownership will be shared by the Government (81%) and Oxylibya (19%). Worley Engineering Inc. of Houston, Tex., was awarded a $120 million contract by Oxylibya for construction of 183 kilometers of 16- and 20-inch pipelines and facilities for the three fields.

Elf-Aquitaine reported two oil discoveries along with a large gas discovery west of Tripoli in the Zuara offshore area. Commercial development was expected to begin in 1978. Mobil Oil Libya Ltd. announced a number of onshore discoveries, with plans for exploitation at a rate of 100,000 barrels per day.

The largest expansion project was undertaken by Government-owned Arabian Gulf Exploration Co. (AGECO) in Sarír and Mussala fields in eastern Libya. Capacity at Sarír field was to be increased to 600,000 barrels per day and that at Mussala field to 400,000 barrels per day.

NOC increased the capacity of the Záwiyah refinery from 60,000 barrels to 120,000 barrels per day, completing the second phase of a three-phase expansion that is to increase capacity to 180,000 barrels per day. Built by Italy's Ente Nazionale Idrocarburi (ENI) at a cost of $38 million, the Záwiyah refinery has processed over 41 million barrels of crude oil since opening in September 1974. Construction of a new 220,000-barrel-per-day refinery at Tobruk continued, with completion scheduled for 1979. The refinery is to process crude oil from Sarír field. Refinery products, with the exception of naphtha, will be exported from the terminal at Marsa el Brega; naphtha is to be used for local ethylene production at a planned 1,000-ton-per-day ethylene plant.

The Government agreed to compensate Texaco Inc. and Standard Oil Co. of California for the 1973-74 nationalization of their subsidiaries. The International Court of Justice at The Hague administered the arbitration decision, which stipulated that the subsidiaries, Texaco Overseas Petroleum Co. and California Asiatic Petroleum Co., were each to be reimbursed with Libyan crude oil valued at $76 million.

Arab Petroleum Services Co. (APS) was founded in early 1977 by the 10-member Organization of Arab Petroleum Exporting Countries (OAPEC). Libya was the largest stockholder, with 17% interest in the Tripoli-based firm. Among the objectives of APS was the education and training of Arab nationals in all facets of the petroleum industry for employment in APS subsidiary and joint venture companies.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Libyan pound-dinars (Lpd) to U.S. dollars at the rate of Lpd1 = US$3.38.

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The Mineral Industry of Madagascar

By David E. Morse[1]

Madagascar's economy grew at a rate of 1.2% in 1977 with the gross domestic product (GDP) reaching $1.8 billion.[2] The mineral industry of Madagascar continued to be a small contributor to the nation's primarily agrarian economy but a significant source of foreign exchange during 1977. Madagascar's major mineral products in 1977 were chromite and graphite. Small-scale operations produced a wide variety of semiprecious and ornamental stones including agate, amazonite, celestine, cipoline, jasper, rhodenite, quartz (rose, smoky, and amethystine), tourmaline, and zircon. The island contains large resources of bauxite, chromite, coal, lateritic iron and nickel, limestone, graphite, mica, piezoelectric quartz, rutile, and zircon.

The Government-owned petroleum refinery at Tamatave processed imported crude oil to supply the island's petroleum product requirements. Small private companies produced cement, brick, and glass utilizing domestic mineral resources.

The Mines and Geologic Department was reorganized into five separate divisions in 1977: The Mining Property Division, the Promotion Division, the Geological Division, the Drilling Division, and the Studies, Technical and Documentation Division. The Government has stated that it would own 51% or more of all new mining ventures.

PRODUCTION AND TRADE

Production data are shown in table 1. The major mineral exports were chromite, petroleum products, and graphite. Major imports were crude oil, metal products, cement, and rice during 1977. Trade in mineral commodities is detailed in tables 2 and 3.

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Table 1.—Madagascar: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Beryllium: Beryl concentrate, industrial grade, gross weight	15	17	[e]15
Chromium: Chromite concentrate, gross weight	194,127	221,172	164,710
Gold, mine output, metal content troy ounces	158	160	76
NONMETALS			
Abrasives, natural: Garnet (industrial only) kilograms	1,751	4,281	NA
Cement, hydraulic	58,021	74,000	52,229
Clays: Kaolin	4,307	25,397	2,152
Feldspar kilograms	683	--	1,093
Gem and ornamental stones:			
Agate do	134,400	133,806	147,200
Amazonite do	2,300	2,103	133
Amethyst:			
Gem do	3,100	--	4,700
Geodes do	NA	1,475	NA
Apatite (ornamental only) do	992	5	536
Aragonite	83	121	1,366
Beryl kilograms	5	3	1
Calcite (ornamental only)	317	2	--
Celestine kilograms	39,700	32,462	19,586
Cipoline marble	35	29,700	12,000
Citrine, gem kilograms	147	18	47
Cordierite do	3,900	4,500	49
Garnet:			
Gem do	9	6	--
Other ornamental do	--	1,876	--
Jasper do	11,600	1,730	8,850
Labradorite do	10,400	7,646	4,389
Opal do	4,900	--	--
Quartz:			
Rose quartz do	42,700	92,450	29,019
Geodes do	85	600	NA
Other ornamental do	1,000	1,516	547
Rhodenite do	12,400	3,335	--
Tourmaline:			
Gem do	([2])	--	--
Other ornamental do	2,200	68,000	NA
Graphite, all grades	17,774	17,412	15,727
Mica, phlogopite:			
Block	99	7	NA
Splittings	445	62	NA
Scrap	--	12	NA
Total	544	81	1,498
Quartz, piezoelectric kilograms	254	89	115
Salt, marine	26,247	27,300	26,000
Stone:			
Calcite, industrial	--	3,215	46,915
Quartz, metallurgical	--	107	--
Other: Bastnasite kilograms	--	10	19,586
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	1,154	920	826
Kerosine and jet fuel do	689	482	425
Distillate fuel oil do	1,422	1,160	912
Residual fuel oil do	1,962	554	1,419
Other do	105	81	59
Refinery fuel and losses do	299	1,123	404
Total do	5,631	4,320	4,045

[e]Estimate. [p]Preliminary. NA Not available.

[1]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (including clays, stone, and sand and gravel) presumably were also produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2]Less than 1/2 unit.

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Table 2.—Madagascar: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS			
Aluminum metal including alloys, all forms		r(1)	--
Chromite		r85,458	117,414
Copper metal including alloys:			
Unwrought and scrap		65	89
Semimanufactures		(1)	(1)
Iron and steel semimanufactures		9	2
Lead oxide		76	119
Titanium ore and concentrate		7	--
Zinc metal including alloys, all forms		13	25
Other:			
Ores and concentrates		2	(1)
Metalloids		6	(1)
NONMETALS			
Abrasives, natural		9	1
Clays and clay products		9	--
Fertilizer materials, crude and manufactured		1	--
Graphite, natural		17,021	16,370
Mica, all forms		1,318	845
Pigments, mineral, natural		(1)	(1)
Precious and semiprecious stones (except diamond), including quartz crystal and synthetic stones	kilograms	420,724	489,292
Salt and brine		1,967	1,845
Stone, sand and gravel		58	140
Talc, steatite, soapstone, pyrophyllite		(1)	--
Other		r20,402	19,212
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline	thousand 42-gallon barrels	502	281
Kerosine	do.	286	121
Distillate fuel oil	do.	r361	173
Residual fuel oil	do.	r893	909
Lubricants	do.	r2	(1)
Other:			
Liquefied petroleum gas	do.	r(1)	5
Bitumen and bituminous mixtures	do.	r(1)	--
Unspecified	do.	r1,974	(1)
Total	do.	r4,018	1,489

rRevised.
1Less than 1/2 unit.

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Table 3.—Madagascar: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS			
Aluminum:			
Oxides and hydroxides		181	8
Metal including alloys, all forms		r884	896
Arsenic oxide and acid		2	2
Chromium oxide and hydroxide		3	(1)
Cobalt oxide and hydroxide	kilograms	--	15
Copper:			
Ore and concentrate		(1)	--
Metal including alloys, all forms		91	3
Gold metal, unworked and partly worked	troy ounces	r18,487	1,190
Iron and steel metal:			
Scrap		(1)	--
Pig iron, ferroalloys, similar materials		20	--
Steel, primary forms	kilograms	84	39
Semimanufactures		41,298	23,795
Lead:			
Oxides		17	2
Metal including alloys, all forms		405	239
Magnesium metal including alloys, all forms	kilograms	34	27
Manganese oxides	do	221	80
Mercury	76-pound flasks	2	7
Nickel metal including alloys, all forms	kilograms	28	36
Platinum-group metals including alloys, all forms	troy ounces	96	--
Rare-earth metals including alloys, all forms	kilograms	1,140	475
Silver metal including alloys, all forms	troy ounces	4,726	8,327
Tin:			
Oxide		--	(1)
Metal including alloys, all forms		20	8
Titanium oxides		24	10
Zinc:			
Oxide and hydroxide		22	11
Metal including alloys, all forms		164	444
Zirconium ore and concentrate	kilograms	1,013	--
Other:			
Oxides and hydroxides		124	7
Metalloids		5	9
Metals including alloys, all forms		14	14
Pyrophoric alloys		3	2
NONMETALS			
Abrasives:			
Crude, natural		6	2
Dust and powder of precious and semiprecious stones	kilograms	58	53
Grinding and polishing wheels and stones		62	44
Asbestos		10	3
Barite		93	15
Boron materials:			
Crude natural borates		131	41
Oxide and acid		r3	--
Cement, hydraulic		50,986	23,892
Chalk		120	153
Clays and clay products (including all refractory brick):			
Crude		1,291	31
Products		852	437
Cryolite and chiolite, natural		--	41
Diamond, all grades	thousand carats	160	--
Diatomaceous earth		15	4
Fertilizer materials:			
Crude and manufactured:			
Nitrogenous		4,256	2,105
Phosphatic		r4,874	3,389
Potassic		6,687	7,552
Other, including mixed		1,339	1,072
Ammonia		24	43
Graphite, natural		(1)	(1)
Gypsum and plasters		5,298	2,064
Lime		2,546	276
Magnesite		1	3
Mica, crude and worked		4	4
Pigments, mineral, including processed iron oxide		r65	29
Precious and semiprecious stones (except diamond), including synthetic	kilograms	r3	--
Quartz crystal	do	1	--
Salt and brine		108	17
Sodium and potassium compounds		r5,443	2,650
Stone, sand and gravel:			
Dimension stone		--	5
Gravel and crushed rock, n.e.s		1	8
Quartz and quartzite		(1)	--
Sand, excluding metal bearing		13	9
Sulfur:			
Elemental, all forms		6	11
Sulfur dioxide		3	2
Sulfuric acid		r150	165

See footnotes at end of table.

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Table 3.—Madagascar: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS —Continued			
Talc, steatite, soapstone, pyrophyllite		59	8
Other:			
Crude		r389	879
Oxides and hydroxides of magnesium, strontium, barium		r368	(1)
Bromine, iodine, fluorine		(1)	(1)
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		(1)	--
Carbon black		4	5
Coal including briquets, all grades		19,623	21,554
Coke and semicoke		119	103
Hydrogen, helium, rare gases		3	1
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	5,824	4,196
Refinery products:			
Gasoline	do.	31	21
Kerosine and jet fuel	do.	(1)	(1)
Distillate fuel oil	do.	2	3
Residual fuel oil	do.	4	--
Lubricants	do.	20	9
Other:			
Liquefied petroleum gas	do.	(1)	(1)
Mineral jelly and wax	do.	23	27
Bitumen, bituminous mixtures, other residues	do.	25	45
Unspecified	do.	54	110
Total	do.	159	215
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		49	344

rRevised.
1Less than 1/2 unit.

COMMODITY REVIEW

METALS

Chromite.—Madagascar began significant production of chromite in 1969. During 1977, Kraomita Malagasy, a Government-owned enterprise, operated the nation's only chromite mines at Andriamena and Befandriana Nord. Chromite production decreased significantly in 1977 from the record high output of 1976 but represented the third highest output since 1969. The Government planned to build a 30,000-ton-per-year ferrochromium plant scheduled to come on line in 1982 and use power from the Rogez-Andekaleka hydropower scheme.

Iron Ore.—A program of drilling, prospecting, and chemical analysis was conducted on the Soalala iron ore deposits during 1977. The deposits, located near the western coast 150 kilometers south of Majunga, were estimated to contain 300 million tons of ore.

Nickel.—No progress toward developing the 120-million-ton lateritic nickel deposit at Ambotavy near Moramanga was reported in 1977.

Other.—Beach sand deposits containing zircon, ilmenite, monazite, and rutile have been investigated on the eastern coast near Tamatave and near Fort-Dauphin. Montedison S.p.A. of Italy set up a pilot plant south of Tamatave to recover ilmenite, zircon, and monazite using gravity separation.

NONMETALS

Cement.—During 1977, Madagascar's only cement plant at Amboanio near Majunga operated at 87% of rated capacity. To combat the island's shortage of cement, the Government investigated several sites near Tuléar, Antsirabé, and Moramanga for the construction of a new cement plant. Expanding the Amboanio facility was also under study.

Gem Stones.—A wide variety of gem, semiprecious, and ornamental stones was produced by small-scale operations during 1977. The more important products were beryl, garnet, amethyst, moonstone, tourmaline, and agate.

Graphite.—Madagascar has produced and exported graphite for 70 years with total production amounting to slightly over 900,000 tons since 1907. The industry has

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remained essentially unchanged for the past 20 years. The 1977 output of 15,700 tons was 9.7% less than the 1976 output. Any change in production will be dependent on what the Government decides concerning its level of participation in the graphite mining industry. During 1977, production came from six privately owned family operations.

Mica, Phlogopite.—The mica industry of Madagascar was centered in a triangular region in the southern part of the island near Fort-Dauphin. In 1977, mica production recovered from the poor showing recorded in the previous year. Output of high-quality block and splittings, however, remained depressed.

MINERAL FUELS

Petroleum.—No petroleum exploration activity was conducted in Madagascar during 1977. The only rightsholder at yearend was Oceanic Resources Ltd. in two offshore blocks totaling 76,250 square miles. Hunting Geology and Geophysics Ltd. of the United Kingdom conducted aeromagnetic surveys in the Fort-Dauphin and Majunga areas for the Government. The Tamatave petroleum refinery processed 491,000 tons of imported crude oil during 1977, a 6% decrease from that of 1976.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Malagasy francs (FMG) to U.S. dollars at the rate of FMG241 = US$1.00.

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The Mineral Industry of Malaysia

By E. Chin[1]

The Malaysian gross national product (GNP) in 1977 was $12.2 billion[2] in current market prices, compared with $10.8 billion in 1976. In terms of constant 1970 prices, the GNP in 1977 was $8.2 billion, a real growth of 8% over that of 1976. The gross domestic product (GDP) in 1977 was $7.4 billion in 1970 prices and was distributed by sector as follows, in millions: Agriculture, forestry, and fishing, $2,111; manufacturing, $1,203; wholesale and retail trade, $973; public administration and defense, $580; banking, insurance, and real estate, $524; transport, storage, and communications, $508; mining and quarrying, $351; construction, $340; electricity and water services, $192; and other, $606.[3] Most sectors of the economy experienced further growth over that of the previous year. The agriculture, forestry, and fishing sector grew only 1.3% in 1977, largely as a result of weaker demand for sawn logs and sawn timber. Growth in the mining and quarrying sector was 8.3% in 1977 because of a fairly large increase in crude petroleum output.

The construction and manufacturing sectors showed increases of 12% and 16%, respectively. Construction was buoyed up by demand for residential housing and by public sector investments in infrastructure. The growth in the manufacturing sector resulted from increased domestic spending and increased export demand for locally produced goods.

As reflected by the consumer price index (CPI), inflation in 1977 accelerated about 4.5% compared with 2.2% in 1976. The increase in the CPI was chiefly a result of higher cost for food, rent, fuel and power; clothing and footwear; and medical and health expenses.

Total employment in 1977 was about 4.2 million, compared with a total available labor force of 4.5 million. The slowdown in economic activity in 1977 resulted in a lower rate of new jobs created during the year. The majority of jobs continued to be provided by the agriculture, forestry, and fishing sector, which employs 44% of the labor force.[4] New jobs in these industries collectively increased only 1.3%, although conditions were buoyed up by higher prices for rubber and a general upswing in the timber industry. New jobs in manufacturing increased 12% in 1977; public administration and defense 6.5%; wholesale and retail trade 5%; transport, storage, and communications 4%; and construction 3.9%.

Employment in the mining and quarrying sector increased only 0.4% as a result of declining production from mines. However, the growing importance of petroleum was expected to offset the decline in output in the tin industry. At yearend, 39,753 persons were employed in the mining industry. Tin operations were by far the largest, employing 38,474; followed by bauxite, 239; iron, 222; and other, 818. Employment data in the oil industry were not available. At yearend, there were 874 individual operating units mining tin (784 gravel pumps, 53 with dredges, 37 with other means), 12 for gold, 11 for china clay, 6 for iron ore, and 1 for bauxite.

There was a marked reduction in labor-management disputes in 1977 compared with 1976. During the year, 28 strikes involving 5,905 workers resulted in the loss of 55,679 man-days. As in previous years, the manufacturing sector had the largest number of strikes. During the year, 94 collective agreements were signed in the private sector. The largest number of agree-

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ments (49) were signed in the manufacturing sector and the least (2) in the mining and quarrying sector. The average increase in wages covered by the agreements, by industry, was as follows: Manufacturing and services 17%, agriculture 16%, commerce and transport 13%, and mining 12%.

The exchange rate of the Malaysian ringgit to all major currencies except the Japanese yen strengthened during the year. Vis-à-vis the U.S. dollar, the ringgit's position improved significantly owing to the weakened dollar as reflected by U.S. inflation and a widening deficit in the U.S. trade account. The ringgit appreciated 2.3% in the first quarter, from M$2.5334=US$1.00 at the beginning of January to M$2.4760=US$1.00 on April 8. It weakened slightly in late April, recovered its position by July, and then depreciated slightly (0.4%) in August, owing to substantial commercial exchanging of the currency for U.S. dollars, particularly by oil companies operating in Malaysia. On the whole, the ringgit showed an appreciation of 3% against the U.S. dollar.

PRODUCTION[5]

By value crude petroleum was Malaysia's most important mineral commodity. In 1977, total industry output by the three producing companies, Exxon Production Malaysia, Inc., Sarawak Shell Bhd., and Sabah Petroleum Co. Ltd., averaged close to 185,000 barrels per day. During the year, the average price for Malaysian crude petroleum (Miri light crude, Labuan crude, and Tembungo crude) was $14 per barrel, f.o.b. However, the crude oil output was small by world standards, constituting less than 1% of total world output. Malaysia is the world's largest producer of tin, accounting for about 25% of world mine production. Production of tin-in-concentrates during the year was almost 1.3 million piculs, averaging about 75% tin. Under the Fifth International Tin Agreement, the price per picul was raised from $430 to $480, effective July 15, 1977. In addition, there are two large tin smelters—Butterworth and Penang. Production of tin-related minerals included significant quantities of ilmenite, zircon, and monazite. Small quantities of columbite, gold, scheelite, tantalite, wolframite, and xenotime were also produced as byproducts of tin-mining operations.

Output of bauxite continued to decline owing to the lower tenor of ore and gradual depletion of deposits as well as reduced demand by foreign markets. Mine copper was produced at the Mamut mine in Sabah. Malaysia also produced small quantities of antimony, manganese, barite, and kaolin. The average production of associated natural gas from petroleum production was estimated at 352 million standard cubic feet per day. However, only 20% of the gas is utilized, and the remainder is simply flared.

Table 1.—Malaysia: Production of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity[2]		1975	1976	1977[p]
METALS				
Aluminum, bauxite, gross weight	thousand tons	704	660	616
Antimony, mine output, metal content (Sarawak)		250	250	440
Columbium and tantalum concentrate, gross weight		50	46	45
Copper, mine output, metal content[e 3]		[r]3,800	18,200	23,000
Gold, mine output, metal content:				
West Malaysia	troy ounces	2,484	3,574	4,172
Sarawak	do.	1,192	965	742
Total	do.	3,676	4,539	4,914
Iron and steel:				
Iron ore and concentrate	thousand tons	348	308	328
Pig iron and ferroalloys[e]	do.	180	190	190
Crude steel[e]	do.	195	200	200
Manganese ore and concentrate, gross weight		133,308	94,112	45,896
Rare-earth minerals:[4]				
Monazite, gross weight		3,285	1,879	1,977
Xenotime (yttrium mineral), gross weight		53	139	75

See footnotes at end of table.

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Table 1.—Malaysia: Production of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity[2]		1975	1976	1977[p]
METALS —Continued				
Tin:				
Mine output, metal content		[r]64,364	63,401	58,703
Smelter output[5]		83,068	78,018	66,305
Titanium: Ilmenite concentrate, gross weight[4]		112,248	180,004	153,680
Tungsten, mine output, metal content		106	64	99
Zirconium: Zircon concentrate, gross weight[4]		10,357	3,129	1,810
NONMETALS				
Barite		814	6,096	11,074
Cement, hydraulic	thousand tons	1,446	1,739	[e]1,742
Clays, kaolin		16,795	26,252	31,856
MINERAL FUELS AND RELATED MATERIALS				
Gas, natural (Sarawak):				
Gross production	million cubic feet	[r e]88,000	104,728	95,850
Marketed production	do.	[r]20,000	21,874	32,755
Petroleum:[6]				
Crude	thousand 42-gallon barrels	35,774	60,547	66,984
Refinery products:				
Gasoline	do.	3,942	6,210	6,733
Jet fuel	do.	1,055	[r] 1,550	1,203
Kerosine	do.	1,938	2,050	2,436
Distillate fuel oil	do.	6,169	8,900	9,694
Residual fuel oil	do.	10,039	10,560	14,405
Other	do.	4,965	4,760	4,811
Refinery fuel and losses	do.	948	510	674
Total	do.	29,056	34,540	39,956

[e]Estimate. [p]Preliminary. [r]Revised.

[1]All production is from West Malaysia unless otherwise indicated.

[2]In addition to the commodities listed, a variety of crude construction materials (clays, sand, gravel, stone, salt, and fertilizer) are produced, but production is not reported and available information is inadequate for the formulation of reliable estimates of output levels.

[3]Estimates based on exports of copper concentrates.

[4]Based on export figures.

[5]Includes small portions of tin from smelter in Singapore.

[6]Includes production from Sarawak and West Malaysia.

TRADE[6]

The total value of Malaysia's two-way trade in 1977 was estimated at $10.5 billion (exports, $6.0 billion, and imports, $4.5 billion). By industrial trade classification, Malaysia was a net importer of food, beverages and tobacco, chemicals, and machinery and transport equipment. The country was a net exporter of inedible crude materials, mineral fuels, animal and vegetable oils, and manufactured goods and articles.

Malaysia's export markets, by area, in 1977 were as follows, in billions: The European Economic Community (EEC), $1.2; other Western European countries, $0.1; Eastern European countries, $0.2; the Association of Southeast Asian Nations (ASEAN), $1.2; other Asian countries, $2.0; Australia and New Zealand, $0.1; North America, $1.1; Africa and South America, $0.04 each; and other countries, $0.01. Imports by major area were, in billions: EEC, $0.8; other Western Europe, $0.9; ASEAN, $0.7; and other Asian countries, $1.9.

Malaysia's leading export commodity was rubber, valued at $1,352 million; followed by timber materials, $999 million; crude petroleum, $763 million; crude and refined palm oil, $727 million; and tin and tin-in-concentrates, $681 million. Copper concentrates exported during the year were valued at $34 million and refined petroleum products at $81 million.

Malaysia currently accounts for about one-fourth of the world's production of tin. Tin accounts for about 90% of the value of all Malaysian mineral exports, excluding petroleum. The United States, Japan, and the EEC were the major markets for Malaysian tin, consuming collectively about 80% of total Malaysian tin exports. Other mineral exports included bauxite, copper concentrate, ilmenite, iron ore, and manganese ore. The bulk of these exports went to Japan.

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Table 2.—Malaysia: Exports and reexports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum:		
Bauxite	649,373	523,819
Alumina	21	8
Metal including alloys:		
Scrap	904	2,318
Unwrought	18	(2)
Semimanufactures	727	920
Columbite ore	83	116
Copper:		
Ore	13,278	81,354
Metal:		
Scrap	2,351	1,794
Unwrought and semimanufactures	651	840
Iron and steel:		
Iron ore thousand tons	r93	9
Metal:		
Scrap	3,660	15,993
Pig iron, ferroalloys, similar materials	86	288
Steel, primary forms	388	983
Semimanufactures:		
Bars, rods, angles, shapes, sections	4,113	2,171
Universals, plates, sheets	2,294	5,875
Hoop and strip	424	390
Rails and accessories	103	345
Wire	489	286
Tubes, pipes, fittings	6,151	7,210
Castings and forgings, rough	754	819
Lead:		
Oxide	102	25
Metal including alloys, all forms	290	719
Magnesium metal including alloys, all forms	1	(2)
Manganese ore	108,351	23,737
Mercury 76-pound flasks	9	(2)
Nickel metal including alloys, all forms	21	176
Platinum-group metals and silver:		
Platinum group troy ounces	15	--
Silver do	2,392	4,404
Rare-earth metals and monazite	(2)	--
Thorium ore	3,338	2,018
Tin metal including alloys:		
Scrap	10	4
Residues (slag and hardhead)	12,398	19,402
Unwrought	r77,991	81,610
Semimanufactures	2	1
Titanium:		
Ore and concentrate, ilmenite	112,248	180,005
Oxide	97	5
Tungsten ore and concentrate	279	150
Zinc:		
Oxide	30	160
Metal including alloys:		
Scrap	187	359
Blue powder	7	94
Unwrought	292	87
Semimanufactures	134	347
Zirconium, ore and concentrate	10,407	3,131
Other:		
Ore and concentrates	529	725
Ash and residue containing nonferrous metals	1,025	1,486
Oxides, hydroxides, peroxides of metals, n.e.s	3	--
Metals including alloys, all forms	r16	17
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, etc	2	3
Grinding and polishing wheels and stones	r49	25
Asbestos	3	35
Barite and witherite	5,342	1,747
Boron materials, crude	5	4
Cement	22,713	8,219
Chalk	1	1
Clays and clay products (including all refractory brick):		
Crude:		
Kaolin	9,865	11,921
Bentonite	7	(2)
Fuller's earth	57	--
Other clays	997	3,725
Products:		
Refractory	1,932	1,451
Nonrefractory	8,358	9,248

See footnotes at end of table.

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Table 2.—Malaysia: Exports and reexports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS —Continued			
Diamond	value, thousands	$86	$98
Diatomite and other infusorial earth		6	1
Feldspar, fluorspar, etc		42	36
Fertilizer materials:			
Crude, phosphatic		53	70
Manufactured:			
Nitrogenous		r22	12
Phosphatic		--	7
Potassic		--	1
Other, including mixed		r10,037	33
Ammonia		161	190
Graphite		2	10
Gypsum and plasters		78	1,270
Lime		16,392	17,007
Magnesite		5	--
Pigments, mineral:			
Natural, crude		24	35
Iron oxides, processed		9	2
Pyrite, unroasted		1	19
Salt and brine		2,646	1,267
Sodium and potassium compounds, n.e.s.:			
Caustic soda		202	4
Caustic potash, sodic and potassic peroxides		13	18
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked		566	7
Worked		301	371
Dolomite, chiefly refractory grade		634	1,011
Gravel and crushed rock		972,083	1,250,185
Limestone, except dimension		25,277	25,626
Quartz and quartzite		184	568
Sand, excluding metal bearing		51,624	188,932
Sulfur:			
Sulfuric acid		20	199
Elemental		r2	13
Talc, steatite, soapstone, pyrophyllite		283	473
Other nonmetals, n.e.s.:			
Crude		257	32
Oxides, hydroxides, and peroxides of barium, magnesium, and strontium		(2)	--
Slag, dross, and similar waste, not metal bearing		7	72
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		9	7
Carbon black and gas carbon		17	17
Coal and coal briquets		r30	26
Coke and semicoke		186	96
Hydrogen, helium, rare gases	value	r$36,741	$23,436
Petroleum:			
Crude	thousand 42-gallon barrels	r24,977	49,472
Partly refined	do	r4,275	6,169
Refinery products:			
Gasoline	do	r240	113
Jet fuel	do	3	1
Kerosine	do	611	710
Distillate fuel oil	do	r173	215
Residual fuel oil	do	r8	14
Lubricants	do	203	235
Other:			
Mineral jelly and wax	do	(2)	(2)
White spirit	do	8	(2)
Nonlubricating oils, n.e.s	do	11	9
Bitumen and bituminous mixtures, n.e.s	do	2	6
Liquefied petroleum gas	value	r$198,782	$4,090
Unspecified	thousand 42-gallon barrels	r1,227	1,570
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		483	343

rRevised.

[1]Data for 1975 and 1976 exclude intrastate trade.

[2]Less than 1/2 unit.

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Table 3.—Malaysia: Imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS			
Aluminum:			
Bauxite		508	1,002
Oxide and hydroxide		4,332	4,201
Metal including alloys, all forms		r12,229	16,404
Antimony metal		30	60
Arsenic trioxide, pentoxide, acid		5,413	910
Chromium:			
Chromite		127	135
Oxide and hydroxide		54	47
Cobalt, oxide and hydroxide		r1	1
Columbium and tantalum, ore and concentrate		--	5
Copper:			
Ore and concentrate		r3	14
Metal including alloys, all forms		7,241	8,301
Iron and steel:			
Ore and concentrate		r33	11
Metal:			
Scrap		6,057	2,777
Pig iron, including cast iron		8,520	7,039
Sponge iron, powder, shot		265	173
Ferroalloys:			
Ferromanganese		1,407	1,824
Other		1,437	1,191
Steel, primary forms		14,109	29,505
Semimanufactures:			
Bars, rods, angles, shapes, sections		191,915	201,202
Universals, plates, sheets		227,602	317,785
Hoop and strip		17,771	13,517
Rails and accessories		5,731	7,691
Wire		14,102	7,715
Tubes, pipes, fittings		54,873	27,998
Castings and forgings, rough		2,508	2,303
Lead:			
Ore and concentrate		38	2
Oxides		697	1,300
Metal including alloys, all forms		3,312	4,416
Magnesium metal including alloys, all forms		1	2
Manganese:			
Ore and concentrate		1,047	2,027
Oxides		503	986
Mercury	76-pound flasks	1,150	372
Molybdenum metal		18	13
Nickel metal including alloys, all forms		r366	323
Platinum-group metals including alloys	troy ounces	911	2,438
Silver	do.	15,086	10,016
Tantalum metal, all forms		r20	5
Tin:			
Ore and concentrate		27,772	12,349
Slag and hardhead		r700	--
Metal including alloys, all forms		190	372
Titanium:			
Ore and concentrate		27	42
Oxides		2,115	3,331
Tungsten, ore and concentrate, gross weight		60	(2)
Zinc:			
Ore		41	29
Oxide		154	200
Blue powder		49	67
Metal including alloys, all forms		r7,915	13,385
Zirconium, ore and concentrate		206	49
Other:			
Ore and concentrate		r128	138
Ash and residue containing nonferrous metals		266	205
Oxides, n.e.s		r(2)	1
Metal including alloys, all forms		r152	62
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, etc		220	212
Dust and powder of precious and semiprecious stones	value	r$1,151	$1,118
Grinding and polishing wheels and stones		674	1,223
Asbestos		19,932	19,281
Barite and witherite		9,545	8,271
Boron materials:			
Crude natural borates		48	152
Oxides and acids		202	126

See footnotes at end of table.

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Table 3.—Malaysia: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS —Continued			
Cement		466,147	342,738
Chalk		280	836
Clays and clay products:			
Crude:			
Bentonite		2,307	2,572
Kaolin		1,313	1,544
Fuller's earth		2,490	3,325
Mullite, chamotte, dinas earth		4	43
Other		2,859	13,215
Products:			
Refractory		11,131	10,112
Nonrefractory		7,983	8,135
Cryolite and chiolite		--	101
Diamond:			
Gem, not set or strung	value, thousands	r$1,237	$1,677
Industrial	do	r$6	$41
Diatomite and other infusorial earth		24	178
Feldspar		2,497	6,333
Fertilizer materials:			
Crude:			
Nitrogenous		157	13
Phosphatic		140,698	152,026
Potassic		928	10,716
Manufactured:			
Nitrogenous		64,809	158,861
Phosphatic:			
Thomas slag		--	17
Other		5,103	7,325
Potassic		168,418	229,209
Other, including mixed		35,849	70,061
Ammonia		7,918	3,418
Fluorspar, leucite, etc		1,308	2,533
Graphite, natural		357	427
Gypsum and plasters		51,050	58,645
Lime		r6,665	4,299
Magnesite		130	333
Mica, worked and unworked, including waste		r60	165
Pigments, mineral:			
Natural, crude		87	442
Iron oxides		574	1,162
Precious and semiprecious stone, except diamond:			
Natural	value	r$303,596	$442,419
Manufactured	do	r$21,390	$9,544
Pyrite		13	18
Salt and brine		115,763	115,883
Sodium and potassium compounds, n.e.s.:			
Caustic soda		6,481	10,773
Caustic potash, sodic and potassic peroxides, natron		16,874	22,062
Stone, sand and gravel:			
Dimension stone, crude and worked		r3,302	3,239
Dolomite, chiefly refractory grade		520	33
Gravel and crushed rock		1,159	2,845
Limestone (except dimension)		516	1,229
Quartz and quartzite		r25	33
Sand, excluding metal bearing		1,005	1,695
Sulfur:			
Elemental		16,205	14,933
Sulfur dioxide		3	16
Sulfuric acid		496	2,620
Talc, steatite, soapstone, pyrophyllite		3,182	4,798
Other nonmetals, n.e.s.:			
Crude		22,149	32,970
Slag, dross, and similar waste, not metal bearing		59	402
Oxides and hydroxides of magnesium, barium, and strontium		182	492
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		1,290	2,158
Carbon black		6,171	10,410

See footnotes at end of table.

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Table 3.—Malaysia: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Coal, coke, briquets:			
Anthracite and bituminous coal and briquets		15,985	22,514
Lignite and lignite briquets		([2])	12
Coke and semicoke		10,509	14,843
Hydrogen, helium, rare gases	value	r$128,654	$54,116
Peat		69	80
Petroleum:			
Crude	thousand 42-gallon barrels	20,466	23,514
Partly refined	do.	2,581	4,323
Refinery products:			
Gasoline	do.	r1,255	1,152
Jet fuel	do.	81	35
Kerosine	do.	978	659
Distillate fuel oil	do.	4,601	3,534
Residual fuel oil	do.	1,950	2,816
Lubricants	do.	r514	723
Other:			
White spirits	do.	23	35
Mineral jelly and wax	do.	40	50
Nonlubricating oil	do.	42	29
Petroleum coke	do.	1	1
Bitumen and other residues	do.	133	144
Liquefied petroleum gas	value, thousands	r$3,584	$3,349
Not specified	thousand 42-gallon barrels	r64	186
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		2,159	3,161

rRevised.
[1]Data for 1975 and 1976 exclude intrastate trade.
[2]Less than 1/2 unit.

COMMODITY REVIEW[7 8]

METALS

Aluminum.—Bauxite was mined at Telok Ramunia in Johore State by Southeast Asia Bauxites Ltd., a subsidiary of Aluminum Co. of Canada Ltd. (Alcan). Annual mine output has decreased from the 1-million-ton level during 1969-73 to about two-thirds of this in 1977 owing to lower grade ore rather than to decreased export demand. Ore reserves at Telok Ramunia were estimated to be about 10 million tons. Because Malaysia lacks smelter facilities, its bauxite production is exported to Japan, as in previous years.

Because of increased costs for energy, large companies such as Reynolds Metals Co. of the United States, Aluminum Péchiney of France, and Hyundai Heavy Industries of the Republic of Korea were interested in establishing aluminum reduction facilities in Malaysia. The Sabah and Sarawak State governments have been negotiating agreements to study the feasibility of constructing smelter facilities at Labuan Island and Bintulu, respectively. Because of increased oil production, large amounts of associated natural gas were simply flared from Malaysia's offshore oilfields rather than being utilized. A smelter at Labuan Island would use natural gas for generating electric energy, inasmuch as the island serves as the supply base for oil operations in Sabah. An aluminum smelter in Sarawak might initially use natural gas from the Bintulu field but would eventually use hydropower from the Rajang River.

Bauxite has been discovered at eight locations in Sabah, although the grade and extent of the deposits remain undetermined. Sarawak has proven reserves of bauxite, but they are too small to supply the requirements of a 100,000-ton-per-year smelter. It was expected that alumina could be produced from locally mined and imported bauxite. If viable, the natural-gas-fed Sabah project could be completed in about 3 years, compared with the 7 to 10 years required to complete the hydroelectric-power-based Sarawak project and its associated infrastructure.

Copper.—Production of copper concentrate (grading 28% copper) from the Mamut porphyry copper mine in Sabah, managed by Overseas Mineral Resources Develop-

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ment, increased from 78,000 tons in 1976 to close to 100,000 tons in 1977. Mamut has reserves estimated at 196 million tons of dioritic porphyry ore grading 0.576% copper. Mine output capacity was rated at 16,000 tons of ore per day, with the associated mill capacity rated at 30,000 tons of contained copper per year. The concentrate is transported by dump trucks to Usukan Bay, 115 kilometers northwest of the mine-mill site, and then shipped to Japan for smelting and refining.

Iron Ore.—Since the closing of the Bukit Ibam mine at Rompin in 1970, mine production of iron ore has declined to about 300,000 tons in recent years. Total output in 1977 was 328,000 tons, an increase of 6% from that of 1976. Iron ore was mined from relatively small deposits by six operations in Pahang, Johore, Perak, and Kedah States, all of which are in Malya. Production in Pahang accounts for about one-half of the total output. Although deposits of high-grade ore exist in Malaysia, none contain sufficient reserves to support profitable mining.

Tin.—Malaysia was the world's largest producer of tin-in-concentrate and refined metal, as well as the world's largest exporter of tin. Output of tin-in-concentrate totaled 58,703 tons in 1977, representing a decline in annual production for the fifth consecutive year. Production of tin metal was produced by the Butterworth and Penang smelters.

At yearend, there were 874 active tin operations in the country, which included 53 using dredges (mainly in Perak and Selangor), 784 using gravel pumps and 37 hydraulic, opencast, and underground mining operations. At yearend 1976, there were 51 dredges, 724 gravel pumps, and 36 other operations. Dredging accounted for 35% of total output; gravel pumping 51%; and hydraulic, opencast, and underground mining operations, 14%.

Output of tin-in-concentrate in 1978 was projected to remain at the same level as in 1977. Higher prices for tin were not expected to be a sufficient inducement for higher production. The principal problems facing the industry were lower yield in existing operating areas, higher costs, administrative difficulties, and a heavy tax burden.

The productivity of gravel-pumping operations was presently estimated at 0.2 kati (or catty[9]) of tin ore per cubic yard, compared with 0.25 kati in the 1960's. About 90% of the gravel-pumping operations (88% of which are located in Perak and Selangor), were previously mined working areas. Dredging operations had even lower productivity, yielding 0.1 to 0.2 kati per cubic yard, compared with 0.2 kati in the 1960's. Between 1974 and 1976, the cost of power rose 14.5% for pumping operations and by 5.5% for the dredging sector. The cost in salaries for both types of operations increased 7.8%. Also, the tin industry charged that it was having difficulty obtaining new mining lands from the State Governments and in renewing mining leases and prospecting licenses.

Total employment in the industry declined from 39,736 in 1975 to 36,828 in 1977 owing to the closure of marginal mines. However, by yearend, employment reached 38,474, mainly because 60 additional gravel-pumping units came into operation during the year. Of total employment, 23% was in dredging operations, 63.5% in gravel-pumping operations, and 13.5% in opencast and underground mining operations.

Tin producers pay several direct and indirect taxes such as export duty and surcharge, tin profit tax, and income tax. Producers attributed the higher cost of production mainly to the heavy tax burden. The States of Malaysia Chamber of Mines estimated that about 70% of the gross profits from tin sales is taken by various taxes, of which 30% were for export duty and surcharge alone. To encourage further investment in the industry, the Government was reviewing the tin tax structure. As a first step, the import duties on stationary diesel engines and water pumps were reduced to 10% from 25% and 30%, respectively. The Government proposed the introduction of a new national mining code, which would standardize and streamline procedures governing prospecting, alienation, issue and renewal of leases, conversion, and other matters. Both State and Federal Governments were to agree to the formulation and implementation of the policy guidelines and on the advisement of the National Land Council; the State Governments could adopt the code for local implementation in their respective states.

The Federal Government continued to encourage Malaysian equity sharing in the industry. In 1976, Pernas Securities, through its wholly owned subsidiary Tradewinds Sendirian Berhad, purchased 71.35%

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of the shares held by London Tin Corp., the company that accounts for about 28% of the tin output in Malaysia. In 1977, the Government disbursed $68 million in loans to Pernas for purchasing shares in major foreign companies including Har Par, London Tin, and Sime Darby, to be held in trust for the Bumiputras (Malaysians regarded by the Government as of indigenous ethnic origin). At the beginning of 1977, 33 mines were operated by Bumiputras and 25 mines were joint ventures with non-Bumiputras. These mines were mainly gravel-pumping operations producing 4 to 7 tons of tin concentrate per month. In June 1977, the domicile of Malayan Tin and Kamunting Tin Dredging Ltd. was transferred from the United Kingdom to Malaysia. The process of transferring the domicile of Southern Kinta Consolidated and Southern Malayan Tin Dredging Ltd. was also expected to be completed during the year.

The Malaysian Mines Department was carrying out prospecting in Malay Reservation Areas to locate and evaluate potential new tin deposits in the country. About 393 hectares of Malay Reserves were to be prospected in 1977, and 290 hectares were earmarked for evaluation in 1978.

A feasibility study on establishing a Tin Exchange in Kuala Lumpur was being carried out by the Ministry of Primary Industries. A preliminary draft of the report was completed on establishing an exchange as part of the overall program to set up a multicommodity exchange dealing with the country's exports of major primary products such as tin, rubber, and palm oil. If the plan is implemented, Kuala Lumpur would become an important terminal market for Malaysia's major export goods.

Titanium.—A major mineral obtained as a byproduct of alluvial tin mining is ilmenite, an iron-titanium oxide. Malaysian ilmenite assays about 53% TiO_2, but higher grades (up to 65% TiO_2) have been recovered at Sungkai in Perak and at Petaling in Selangor. Production of ilmenite, all from Malaya, totaled close to 154,000 tons in 1977.

Malayan Tin Smelting and Finance Co. Sdn. Bhd. began operating its new titania plant at Lahat, using local ilmenite as a raw material. However, plant operations were discontinued near the end of the third quarter of 1977. The closure was reportedly owing to technical difficulties in the acid leach process, which yielded a lower quality synthetic rutile.

Other.—Recovery of other metals from tailings of dredging operations included columbite, scheelite, zircon, and two rare-earth minerals, monazite and xenotime. Small quantities of wolframite concentrate were recovered as a byproduct of alluvial tin operations; however, the major source of tungsten production in Malaysia was a wolframite lode in Pahang. Gold was recovered as a byproduct of tin-dredging operations at Batang Padang District and Kuala Lumpur, and from small-scale mining operations in the Raub and Bau District in Sarawak.

NONMETALS

Cement.—Malaysia's value-added in the construction sector increased 11.8% in 1977 as a result of the stimulus of increased residential and public sector building projects. Domestic resources of limestone and sand and gravel are abundant and ensure a readily available supply for the construction industry. Cement production in 1977 was about 1.7 million tons. Price increases are subject to approval by the Ministry of Trade. The price of cement, however, remained stable in 1977 at about $3 per kilogram bag. On a nationwide basis, total supply was adequate to meet demand; locally, cement production outstripped demand by 20% in Malaya but lagged behind demand by about 17% in Sabah and Sarawak.

Malaysia's largest cement producer was Tasik Cement Bhd. in Ipoh, which has an annual output capacity of 1.04 million tons. Other cement producers in the country were as follows, with capacity expressed in thousand tons per year: Associated Pan Malaysia Cement Sdn. Bhd., 900; Cement Industries of Malaysia Sdn. Bhd., 400; and Malaysia Industrial and Mining Corp. Bhd., 60.

Associated Pan Malaysia Cement was considering constructing an additional facility to supplement the output of its Rawang works, thereby increasing its capacity to 1.2 million tons per year. Final plans were expected to be formalized in 1978. In 1976, the Government approved additional cement projects, Siemen Perak Sdn. Bhd. and Pahang Cement Sdn. Bhd. By the end of 1977, construction on these projects had not been initiated.

Fertilizer Materials.—During 1977, domestic production of nitrogenous, phosphatic, and potassic fertilizers totaled 290,000 tons. Three of the more than 20 producing

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companies accounted for about 35% of the total output. To meet the domestic demand for fertilizers, about 400,000 tons of fertilizers was imported in 1977, consisting mainly of potassic fertilizers (45%); urea (21%); and composite, complex, and compound fertilizers (19%). The major suppliers of fertilizer materials were Christmas Island, Canada, the Federal Republic of Germany, Japan, and the United States.

To maintain fair and reasonable prices for fertilizers, the Government introduced subsidy schemes and also included fertilizers in the essential commodities list under the Control of Supplies Regulations in 1974. In addition, import duty exemptions were granted on all types of imported fertilizers except those produced locally; on these, a protective import duty of about $18 per ton was levied. The import duty exemptions were expected to result in a loss of Federal revenue of only about $1.2 million in 1977.

Domestic demand for fertilizer was expected to increase at an annual rate of 3%. Domestic production was projected to increase 9% in 1978 to 313,900 tons, and imports were expected to decrease 2%. The Government was planning to participate in fertilizer manufacturing, especially in the production of urea. A feasibility study on a urea project assigned to Malaysia under the regional industrialization scheme of the ASEAN was initiated in September 1976 and was to be completed in late 1977.

Other.—The major producing states for crushed rock were Selangor, Johore, Pahang, and Perak. Crushed granite, most of which was used for road metal and concrete aggregate, constituted 68% of total production. The remainder was predominantly limestone, of which about 50% was used for road metal and concrete aggregate, 40% for cement manufacture, and 10% for various specialty uses. Almost all of the output of sand and gravel was used as concrete aggregate. Perak, Johore, Penang, and Pahang were the major producing States.

Kaolin production during the year was almost 32,000 tons. Part of the output was consumed domestically by the ceramics, paint, rubber, plastics, and pesticide industries; the remainder was exported to Japan and Singapore. Domestic ball clay, obtained mostly from alluvial tin mining operations, was used with kaolin for manufacturing wall, floor, and mosaic tiles and sanitary and table ware. Common clay mined locally was used primarily in drainage and sewer pipes, flower pots, and similar uses.

Output of quartz sand and powder was primarily from sand deposits in Johore and from tin tailings operations. Most of the quartz was used domestically by the glass and ceramics industries, and some was exported. Barite production in 1977 was 12,000 tons, all from the Tasek Chini deposit in Pahang.

MINERAL FUELS

Natural Gas.—The total output of associated natural gas in 1977 was estimated at about 96 billion cubic feet. There is no commercial utilization of associated natural gas in Malaysia. Only about 20% was collected and used, about 15% was used as fuel in exploration and production activities, and about 5% was sold to Sarawak Electricity Supply Co. and to brick manufacturers in Miri, Sarawak. The remainder was simply flared.

As part of the National Petroleum Policy, Petronas asked the oil companies working in Malaysia to submit plans to commit the gas to economic use or to conserve it. In addition, Petronas continued negotiations with Shell Oil Co. of the United States and Mitsubishi Corp. of Japan for construction and operation of a liquefaction plant to utilize gas from the Central Luconia fields in Sarawak. Work on the $1 billion proposed plant would begin as soon as final agreement was reached among the partners. The plant, tentatively scheduled for startup in 1982, would have an annual capacity of about 6 million tons of liquefied natural gas.

Petroleum.—Malaysia's National Petroleum Policy was designed to achieve several objectives in protecting the national interest, including sufficient control to enable the country to derive maximum benefit from its oil industry, ensuring an adequate domestic supplier of petroleum and petroleum products, establishing industries related to petroleum and petrochemicals, and ensuring active participation of the national oil company, Petronas. In March, the Petroleum Development (Amendment) Act amended the Petroleum Development Act of 1974. The new legislation repealed the management share provision of the 1974 act. Additionally, the Prime Minister was empowered to exempt such activities as petroleum refining, manufacturing of petrochemical products, and marketing of petroleum or petrochemical products from the licensing requirement of the 1974 act.

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The Amendment Act also made provisions for compensation to any oil company whose rights under the previous Concession License had been abrogated on enforcement of the 1974 act.

By the end of 1976, Petronas had completed ratification of production-sharing contracts with Sarawak Shell Bhd., Sabad, Sabah Shell, and Exxon. The terms and conditions of all contracts were essentially the same and are designed to ensure the development of Malaysia's petroleum resources with maximum yield to the country while assuring the participating oil companies a fair return on their investment. The duration of the contracts was for 20 years with possible extensions of 4 years for oil and 14 years for gas.

Although 19 oilfields of commercial value have been discovered in the offshore areas of Sabah, Sarawak, and Malaya, only 8 were in production in 1977. Sarawak Shell operated 6 fields offshore Sarawak (West Lutong, Baram, Baronia, Tukau, Bakau, and Fairley Baram) with a combined production rate of 116,213 barrels per day. The second largest producer, Sabah Shell, operated its only field at Samarang at 64,305 barrels per day. Exxon, which produced 4,254 barrels per day in June 1976 from its Tembugo Field, increased production sharply to 11,336 barrels per day in June 1977 after settlement was reached on its production-sharing agreement in December 1976. In addition, Exxon had promising oilfields in Pulai, Tapis, Bekok, and Seligi in the South China Sea. The Continental Oil Co. of Malaysia (Conoco) had discoveries at Sotong, Anding, and Duyong (the only natural gasfield found off Malaya, situated a few miles to the south of Exxon's exploration areas). Production from Exxon's new oilfields off the Trenggau coast was expected to come onstream in mid-1978 at an initial rate of about 5,000 barrels per day. Conoco had not yet contracted a production-sharing agreement with Petronas, owing to the need for further detailed studies.

Because Exxon's Pulai and Tapis oilfields in Malaya were expected to begin production in mid-1978 and because of the possibility of production from Sabah Shell's oilfields at Erb West in offshore Sabah, crude oil production in 1978 was projected to increase 7.7% over that of 1977 to 210,000 barrels per day.

The intake of crude oil by the three refineries in Malaysia (the Shell and Exxon refineries at Port Dickson and the Shell refinery at Lutong, Sarawak) averaged about 109,206 barrels per day. About 20% of the production of crude oil was consumed domestically for refining, and the rest was exported. The refinery at Lutong uses only local crude oil; the Port Dickson refineries were designed to refine feedstock in the ratio of 70% imported heavy crude oil to 30% locally produced crude oil. Moreover, the product mix of the output at the Port Dickson refineries meets more of Malaysia's demand, 45% of which was for middle distillates such as diesel fuels and kerosine. Additionally, Malaysia benefits from the export of local crude since this lighter grade commands a higher unit price.

Castrol (Malaysia) Sdn. Bhd. in a joint venture with the Negri Sembilan State Development Corp. completed construction of a lubricating-oil-blending plant at Port Dickson. Initial production was in March 1977 and will be tailored to the needs of the local market. Ninety-nine percent of the lubricating oils now imported by the company will be produced locally by this plant. An oil terminal at Labuan, Sabah, was opened on March 15. This project was a joint venture between Pecten Oil Co. and Sabah Shell. Petronas was also to use this facility. A petroleum supply base with facilities ranging from equipment services for exploration and production activities to food and labor activities was being established at Chukai in Trengganu. This base was to service and facilitate the operations of Exxon and other oil companies operating in the new oilfields off the eastern coast of Malaya. Petronas also began construction of airport refueling projects, whereby Petronas was to participate actively in the marketing and distribution of fuel oil to all Malaysian airports. The first project at the Penang airport was scheduled for completion by mid-1978. A similar network to service Malaysian seaports was also being considered by Petronas, which was currently studying proposals on the supply of bunker fuel at Port Kelang and Pasir Gudang (Johore).

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Malaysian dollars (M$) to U.S. dollars at the rate of M$2.50=US$1.00.

[3]Ministry of Finance. Economic Report, 1977-78. Oct. 28, 1977, 187 pp.

[4]Department of Statistics Annual Statistical Bulletin. August 1977, 91 pp.

[5]U.S. Embassy, Kuala Lumpur, Malaysia. Minerals Questionnaire. State Department Airgram A-41, May 11, 1978, 6 pp.

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[6]Bank Negara Malaysia. Quarterly Economic Bulletin. V. 11, No. 1-2, March-June 1978, 88 pp.

[7]U.S. Embassy, Kuala Lumpur, Malaysia. Industrial Outlook Report—Minerals. State Department Airgram A-009, Jan. 25, 1977, 13 pp.

[8]U.S. Embassy, Kuala Lumpur, Malaysia. Industrial Outlook Report—Minerals Part II. State Department Airgram A-74, May 31, 1977.

[9]1 kati is equivalent to about 1.3 pounds.

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The Mineral Industry of Malta

By Roman V. Sondermayer[1]

The mineral industry of Malta, a small three-island country situated south of Sicily, consisted of salt and limestone production during 1977. The modest demand for fuels, construction materials, fertilizers, diamond, and metals was met through imports.

PRODUCTION AND TRADE

Table 1 shows the latest trends in production of minerals in Malta.

Malta depends on imports of a variety of mineral commodities, but all in small quantities, reflecting the size of the country.

Fuels were the major import and export items, and bunkering was the principal way of exporting fuels. Trade with the United States was modest in value, as shown in table 3.

Table 1.—Malta: Production of mineral commodities

Commodity and unit of measure	1975	1976	1977[p]
Lime—thousand metric tons	34	27	32
Limestone[e 1]—thousand cubic meters	740	962	802
Salt—metric tons	279	290	797

[e]Estimate. [p]Preliminary.
[1]Figures represent reported production plus an estimate for quantitatively unreported output.

Table 2.—Malta: Value of trade in mineral commodities

(Thousand dollars)

Commodity	1975		1976	
	Exports and reexports	Imports	Exports and reexports	Imports
Oxides and hydroxides	6	[r]162	--	261
Metals, including scrap:				
Iron and steel	[r]850	[r]16,422	3,620	12,262
Nonferrous	[r]778	[r]6,720	934	6,658
Cement	--	3,823	22	4,093
Fertilizer materials	[r](1)	[r]402	--	648
Petroleum, crude, and refinery products	18,792	32,193	16,007	32,429
Other	12	[r]3,449	480	4,137

[r]Revised.
[1]Less than 1/2 unit.

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Table 3.—Malta: Mineral trade with the United States, 1976

Commodity	Exports		Imports	
	Quantity (metric tons)	Value, thousands	Quantity (metric tons)	Value, thousands
Aluminum metal including alloys	--	--	(1)	$1
Iron and steel semimanufactures: Tubes and pipes	--	--	93	248
Stone, dimension	18	$5	--	--
Total	XX	5	XX	249

XX Not applicable.
[1]Less than 1/2 unit.

Source: U.S. Department of Commerce, Bureau of the Census.

Limestone and salt were the only two minerals produced in Malta. The size of the country and the lack of a large manufacturing industry limited demand for imported mineral industry products.

Limestone was produced in various locations on the islands of Malta and Gozo. The largest quarries were situated near the capital city of Valletta. Debono Enterprises Ltd., at St. Paul's Bay, was among the major quarry owners and operators.

Salt was produced in Salina Bay on the island of Malta. Lime was in short supply, and during 1977 a feasibility study was completed for a lime plant, using local limestone. No decision was made on actual construction.

Small quantities of imported steel and nonferrous metals were consumed by the manufacturing industry. Some precious metals were consumed by jewelers, and several diamond cutters operated facilities for diamond cutting.

All fuels, both liquid and gaseous hydrocarbons, were imported. Consumption of fuels for bunkering was very large compared with consumption of other mineral commodities. Petroleum refinery products were used by the transportation sector, for production of electricity, and in households. Two power stations with an aggregate capacity of 115 megawatts, fueled with fuel oil, supplied electric power to the island. Besides the electricity-generating facilities, the power station complex included four 1-million-gallon-per-day seawater distillers. The fresh water produced is pumped to the Luga and Ta' Qali water reservoirs. Powerplants and seawater distillers were operated by the Malta Electricity Board, a public corporation.

Liquefied petroleum gas (LPG) was also imported, and the Malta Gas Board operated an LPG bottling plant at B'Bugia, Malta, with storage capacity for 800 tons of LPG.

During 1977, no offshore wells were drilled; sea boundaries between Malta and other countries must be determined before any drilling can start.

[1]Physical scientist, Branch of Foreign Data.

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The Mineral Industry of Mauritania

By Candice Stevens[1]

The mineral industry contributed approximately 45% to the 1977 gross domestic product of Mauritania, estimated at $460 million.[2] However, production of mineral commodities was at a low level owing to low metal prices and depletion of older deposits. Although approximately $500 million was to be invested in mineral development under the third 5-year plan (1976-80), many projects were suspended owing to a shortage of funds. Among the proposed projects were exploitation of low-grade iron ore deposits and construction of a steel mill. Mauritania's foreign debt tripled from 1974 to 1977, and development projects remained heavily dependent on foreign loans and grants.

In 1976, Mauritania adopted a new policy of inviting foreign investment, public or private, in mining and industrial ventures. Most foreign mining ventures in Mauritania had previously been nationalized and placed under Government supervision. A new investment code adopted in 1976 included economic incentives such as tax exemptions, guarantees against nationalization, and provisions for profit repatriation.

Mineral exploration was limited in Mauritania in 1977. Previously, surveys were being conducted by the Bureau de Recherches Géologiques et Minières (BRGM) of France and other foreign groups on deposits of lead-zinc and copper at Adrar, iron ore at Tiris and Tasiast, and copper at Affolé. Portions of the northern Dorsale Reguibat region were under examination for gold (Conchita-Florence), tin (Catherine), and manganese. Black sands along the Atlantic coast were estimated to contain 250,000 tons of ilmenite and were surveyed for rutile, zircon, and monazite content. Extensive phosphate exploration was also conducted in the Senegal River Basin area.

In 1977, the first section of a 1,100-kilometer road that will link the port of Nouakchott and the eastern city of Néma and open up the eastern part of the country was inaugurated. Mauritania had a total of 1,300 kilometers of paved roads. Electricity-generating capacity was to be developed to support various industrial and mining projects. Under the 5-year plan, generating power was to be increased from 54,000 kilowatts in 1977 to 180,000 kilowatts in 1980. The production and distribution of electricity and water in Mauritania was under the direction of the State-owned Soc. Nationale d'Eau et d'Électricité. Construction continued in 1977 on extensions to the port of Nouadhibou, which was scheduled for completion by yearend 1978.

PRODUCTION AND TRADE

Production of Mauritania's major mineral commodities declined in 1977 owing to fluctuating world prices for copper and iron ore and interruptions to operations caused by local political conflict. Iron ore production increased 1.3%, copper production decreased 4.6%, and gypsum production decreased 9.1% from the 1976 output. Mauritania also produced small amounts of by-product gold and silver, and some salt for local consumption.

Exports of iron ore, accounting for approximately 80% of Mauritania's foreign exchange earnings, fell to the lowest tonnage since 1969. In 1977, iron ore exports were approximately 8.4 million tons, earn-

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ing about $130 million in export value. Exports went primarily to France (33%), the United Kingdom, Japan, Italy, and the Federal Republic of Germany. Copper exports reached their lowest level since 1971, at 12,000 tons; the main destinations were Spain and France. Almost all gypsum production was exported to Senegal. Mineral imports consisted of cement, fertilizer, and semimanufactures; Mauritania also imported approximately 860,000 barrels of refined petroleum products in 1977.

Mauritania was a member of the Communauté Economique de l'Afrique Occidentale (CEAO), a regional organization which exempted member nations (Ivory Coast, Upper Volta, Niger, Mali, and Senegal) from customs duties. Mauritania was also a signatory of the Lome Convention, which called for preferential treatment of exports from member African nations into the European Economic Community. In 1975, Mauritania, Venezuela, and Algeria were the first three countries to sign the charter of the Association of Iron Ore Exporting Countries (AIOEC).

Table 1.—Mauritania: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
Copper, mine output, metal content	16,203	9,431	[e]9,000
Gold ---troy ounces	[e]42,000	22,120	[e]20,000
Gypsum	12,669	11,195	10,176
Iron ore and concentrate, gross weight---thousand tons	8,677	9,664	9,794
Rare-earth metals: Monazite concentrate, gross weight[e]	100	100	100
Salt, marine[e]	1,000	1,000	1,000
Silver ---troy ounces	[e]26,000	31,572	[e]26,000

[e]Estimate. [p]Preliminary.

[1]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, stone, and sand and gravel) presumably are also produced, but output is not reported quantitatively and available information is inadequate to make reliable estimates of output levels.

COMMODITY REVIEW

METALS

Copper.—Copper production at Akjoujt decreased from 9,431 tons in 1976 to 9,000 tons in 1977, the lowest output since the mine reached a peak production of 21,277 tons in 1973. Low copper prices, technical difficulties, and departure of foreign technicians led the Mauritanian Government to consider closing down the Akjoujt operation. Copper production was under the direction of the State-owned Soc. Nationale Industrielle et Minière (SNIM).

Reserves of copper oxide ore, with estimated reserves of 2.3 million tons averaging 2.7% copper, are due to be exhausted by 1980. A feasibility study was in progress on the exploitation of copper sulfide reserves, estimated at 13.7 million tons averaging 2.3% copper. Although copper sulfide reserves were considered less difficult to process than the copper oxide ore, new equipment for extraction and concentration was necessary. The $70 million copper sulfide project at Akjoujt was expected to have an annual capacity of 120,000 tons of ore. In 1977, Hawker Siddeley Power Engineering Ltd. won a $4 million contract to increase the output of the Akjoujt power station to 23 megawatts. Commissioning of the power station was scheduled for 1980.

Installation of a copper smelter at Nouakchott by Soc. Arabe d'Industries Métallurgiques was still in the planning stage in 1977. A joint venture of Mauritania and Kuwait, the company was to make an initial investment of $100 million in the construction of the smelter, which was to have an annual capacity of 30,000 tons of copper.

Iron and Steel.—Production of iron ore at Zouérate, situated in northeastern Mauritania near the Spanish Saharan border, increased from 9.7 million tons in 1976 to 9.8 million tons in 1977. The three mines, Tazadit, Rouessa, and F'Derick, were operating below capacity owing to damages suffered during ongoing local political conflict and the departure of foreign technicians. Iron ore production was under the direction

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of Complexe Minièr du Nord (COMINOR), a division of SNIM. Combined reserves of the three mines, where production was to be phased out by 1985, were 100 million tons of ore averaging 65% iron.

The decline in activity at the older mines was to be compensated for by exploitation of lower grade ore reserves in outlying bodies known as the Guelb deposits. Situated within a radius of 50 kilometers of Zouérate, these deposits have total reserves estimated at 1.5 billion tons of magnetite ore averaging 38% iron. In 1977, the evaluation of two magnetite deposits, at El Rhein and Oum Arwagen, was in progress. The development project would include a 37-kilometer spur line from the existing railroad to El Rhein and an additional 26-kilometer extension to Oum Arwagen, facilities for open pit mining of the deposits at the two locations, and concentration through magnetic separation at El Rhein coupled with wet-gravity separation at Nouadhibou. Exploitation was to begin in the mid-1980's with an annual production capacity of 6 million tons. Mauritania was in the process of securing financing for the $500 million project, including a $50 million loan from the International Bank for Reconstruction and Development (IBRD). Other potential sources of capital included Arab Mining Co. ($28 million), Abu Dhabi ($20 million), Saudi Arabia ($60 million), Kuwait ($40 million), the Arab Fund for Loans to African Countries ($35 million), the African Development Bank ($12 million), the European Investment Bank ($25 million), and Caisse Centrale de Cooperation Economique of France ($25 million).

In 1977, Kobe Steel Ltd. (Japan) was contracted by Soc. Arabe d'Industries Métallurgiques to construct an iron ore-pelletizing plant at Nouadhibou. The $130 million plant, to be owned jointly by Mauritania and Kuwait, would have an annual capacity of 2 million tons. Completion was scheduled for 1981.

H. K. Ferguson (United States) was conducting a feasibility study for the construction of a ministeelworks in Nouadhibou. Initial capacity of the steel mill, which would produce rods and bars for construction purposes, was to be 12,000 tons per year. The $10 million plant was to be commissioned in 1980. Energy requirements were to be provided by a new powerplant under construction at Nouadhibou.

Uranium.—Promising uranium mineralization was situated in the northern Tasiast and Dorsale Reguibat regions, but reserves and grade have yet to be evaluated. Prospecting has been carried out since 1975 by Cie. Française des Pétroles (CFP) in conjunction with Péchiney Ugine Kuhlmann (France), Commissariat à l'Énergie Atomique (France), and Tokyo Uranium Development Co. The exploration agreement provided for the Mauritanian Government to acquire a 51% share of any joint venture formed to exploit uranium findings in the 165,000-square-kilometer concession area.

NONMETALS

Gypsum.—Production of gypsum, completely under the control of SNIM, decreased from 11,195 tons in 1976 to 10,176 tons in 1977. The major part of output was exported to Senegal for use in the West African Cement Co. plant at Rufisque. Mining at the gypsum quarry at Sebkha de N'Drahamcha, 65 kilometers north of Nouakchott, began in October 1973. Reserves were estimated at 10 million tons in 1977. SNIM planned the construction of a plasterworks with an annual capacity of 11,000 tons near the gypsum deposits; the output would be used locally.

MINERAL FUELS

Petroleum.—Exploration for petroleum resources in Mauritania was limited in 1977. Most of the foreign petroleum companies, including Texaco Mauritania Inc., Shell Mauritania Co., Esso Co., and Western Enterprises, Inc., relinquished their oil-prospecting concessions in 1975-76 owing to disappointing results. The only active exploration was by the Seagap Group, a consortium including Hispanoil (Spain), Getty Oil Co. (United States), Phillips Petroleum Co. (United States), and Agip S.p.A. (Italy). Hispanoil was the operator for the Group, in which each company had a 25% holding. Approximately 3,000 line-miles of seismic work was completed in Seagap's 24,000-square-kilometer concession area, which included both onshore and offshore areas south of Nouadhibou. No drilling activity was reported in 1977.

L'Unité de Commercialisation des Produits Pétroliers (UCPP), a division of SNIM, was responsible for the sale and distribution of all petroleum products in Mauritania. Under the supervision of UCPP, construction of a petroleum refinery at Nouadhibou neared completion. The Austrian firm Vöest-Alpine AG was contracted to build

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the refinery at an estimated cost of $83 million. Pipelines from the refinery to the export dock were completed in 1977, and startup was scheduled for mid-1978. The refinery was to have an annual capacity of about 7 million barrels of crude oil, supplied primarily by Nigeria. Annual production was to consist of approximately 2 million barrels of gasoline, 1.4 million barrels of diesel fuel, 2.5 million barrels of fuel oil, 580,000 barrels of jet fuel, and 18,000 barrels of liquefied petroleum gas. Approximately one-third of the output was to be consumed domestically, and the balance was destined for European markets.

[1]Economist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Mauritanian ouguiya (UM) to U.S. dollars at the rate of UM44=US $1.00.

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The Mineral Industry of Mexico

By Doris M. Hyde[1]

Mexico's 1977 gross domestic product (GDP) at current prices was $74.2 billion,[2] which represented a 3.2% increase over 1976 if measured in real terms. The mining sector contributed 1.6% of the GDP in 1977, and the petroleum sector accounted for 3.9%. Inflation continued to grow at the rate of 20.7% per year.

Substantial new discoveries of oil and gas were made during 1977, and continued exploration is expected to reveal additional reserves. The petroleum industry has responded well to increased exploration and development expenditures and easily leads all other sectors of the economy in growth and potential. Petroleum revenues have been targeted to play a major role in financing Mexico's future economic growth. The mining sector proved disappointing from a growth standpoint in 1977, mostly due to weak demand and technical and labor difficulties. Improved market conditions and committed expansions in mining and mineral-related industries are expected to substantially increase the economic impact of minerals on the nation.

In cooperation with the Government's policy to expand the economy, 27 member companies of the Mexican Mining Chamber of Commerce, Camara Minera de México (CAMIMEX), had signed in December 1976 an alliance for production agreement with the Government to invest $2.5 billion during the following 6 years. The major portion of this investment, $1.1 billion, was allocated for increasing the capacity and efficiency of existing plants. The remainder was apportioned to the areas of exploration ($105 million), new projects ($650 million), industrialization of metals ($13 million), and other projects ($300 million). As conceived, the plan was expected to double production and increase the value of exports to $4.8 billion by 1982. The creation of 80,000 new jobs was projected but skepticism has been expressed that new employment opportunities would be that high since mining is a capital intensive industry. In 1977, the mineral industries directly employed 150,000 workers. The largest investment commitments were made by Mexicana de Cobre ($450 million), Industrias Peñoles ($375 million), Fundidora Monterrey ($360 million), Cía. Minera de Cananea ($290 million), and Industrial Minera México ($290 million). Investments of lesser magnitude but still of major significance will be made by Cía. Minera Autlán, Las Encinas S.A., Grupo Frisco, Cía. Fresnillo, and the Peña Colorada consortium.

Government Policies and Programs.—The private mining sector in Mexico was granted an extension of time in which to comply with the new mining law of 1975. The new deadline for compliance was established as December 31, 1978.

A new mining tax law was passed in December 1977 with an effective date of January 1, 1978. This new law, the first mining taxation change in 22 years, was favorably received by the mining sector and was generally expected to stimulate development.

The old tax law established five means of taxation: A production tax, a concession tax, a general export tax, an additional 10% export tax on 12 minerals and metals, and a 15% tax on the first sale of gold and silver. The new law reduces these five to two, a tax on production and a tax on concessions. The old production tax included 48 different rates ranging from 1.34% for arsenic trioxide to 20.6% for gold. The new simplified production tax provided only three rates

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based on official values: 9% for gold, silver, and sulfur; 4% for coal, iron, and manganese; and 7% for all other minerals. A greater flexibility in the determination of any official value of minerals was agreed to by the Government. An automatic subsidy of 2% is applied but must be countered by the expenditure of an equivalent sum for exploration and development activities. Accelerated depreciation on mining equipment can go as high as 33% if it is fabricated in Mexico and if the allowance is reinvested within 5 years.

Recent exploration and development activities have encouraged speculation as to Mexico's future petroleum potential. There has been some internal discussion as to whether or not the production rate should be substantially increased to provide an immediate solution to pressing economic problems. The Government's policy has been to use a conservative approach in expanding production to allow for a steady economic growth with only moderate inflation. Gradual production increases were announced that will permit the export of 1 million barrels of oil per day by 1980. Petróleos Mexicanos (PEMEX) continued to be cautious in projecting immense reserve estimates and counseled the Government to maintain a prudent attitude toward exploitation that would not prejudice Mexico's future domestic needs.

The proposed sale of 2 billion cubic feet of natural gas per day to the United States, through a pipeline to be laid from the Reforma region to Monterrey with a branch for delivery to the U.S. border, was well publicized and would result in a substantial boost to the Mexican economy. The sale price of $2.60 to perhaps as much as $2.76 per thousand cubic feet was keyed to the price of No. 2 fuel oil in New York harbor. Gas imported from Canadian sources during 1977 was sold at about $2.16 per thousand cubic feet and the requested increased price for new U.S. gas, as presented in proposed U.S. energy legislation, was $1.75 per thousand cubic feet. The potential wide-ranging impact on various aspects of the U.S. energy sector led to considerable controversy and delayed U.S. Government approval of the Mexican gas transaction. Mexico did not renew its letter of intent with the U.S. pipeline companies.

PRODUCTION

The mining industry represents Mexico's fourth largest foreign exchange earner. Silver, zinc, steel, copper, sulfur, lead, coke, fluorite, gold, and manganese, in that order, were the major earners in the minerals sector of the economy. Iron ore production declined about 2% from the 1976 level due to a prolonged strike but was sufficient to accommodate Mexico's steel plants. Lead, sulfur, and fluorite production also fell below 1976 levels as reflections of depressed market conditions. The other major minerals registered production increases.

On the basis of estimates covering 18 metallic and 26 nonmetallic minerals, the total production value of Mexico's mining industry increased 9%, from $1.1 billion (revised) in 1976 to $1.2 billion in 1977. When stated in Mexican currency, the production value increased almost 60% over that of 1976. The large percentage discrepancy was accounted for by the devaluation of the Mexican peso during 1976.

Crude oil and condensate production averaged 981,071 barrels per day for 1977, a 22.5% increase over 1976. Natural gas liquids production was 104,770 barrels per day, a 12% increase over that of 1976. Lack of transportation and processing facilities resulted in a 3% decline in gross natural gas production from the 2,114 million cubic feet per day produced in 1976. In 1976, 24% of total gas production was flared, but in 1977 this volume was reduced to 13%. As more new cryogenic and absorption plants come into operation, PEMEX expects flaring to decrease, predicting its share at only 2.5% in 1978.

In November 1976, there were 30% and 20% increases in the domestic price of refined and petrochemical products, respectively. These increases were responsible for the apparent 1977 increase of 37.5% over the 1976 value of domestic sales by PEMEX. Domestic sales volumes of petroleum products only increased about 3% over 1976 despite the relatively low composite domestic price per barrel of about $6.50.

In 1977, the petrochemical industry produced 4.2 million tons of petrochemicals from 63 operating plants producing 38 basic derivatives. This represents a 6.4% increase over 1976 production and, if production schedules are met, 1978 should show a 34% increase over 1977. Production in 1980 was projected at 18 million tons of petrochemi-

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cals, including 44 basic derivatives. This impressive production increase will be accomplished through the completion of 37 new plants currently under construction and an additional 39 plants which are in various planning stages.

Table 1.—Mexico: Production of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity[1]		1975	1976	1977[p]
METALS				
Aluminum, primary		r40,090	42,358	e42,600
Antimony:				
Mine output, metal content		3,137	2,546	2,698
Metal (in mixed bars)		972	593	934
Arsenic, white[2]		6,158	5,499	5,744
Bismuth, content of exported concentrate, bullion, and refined metal		445	557	729
Cadmium:				
Mine output, metal content		1,581	1,844	1,781
Metal, refined		586	710	908
Copper:				
Mine output, metal content		78,196	88,970	89,662
Metal:				
Blister		76,374	85,175	87,457
Refined		63,149	75,418	73,062
Gold:				
Mine output, metal content	troy ounces	144,710	162,811	212,709
Metal, refined	do.	132,236	150,722	196,634
Iron and steel:				
Iron ore:				
Gross weight[3]	thousand tons	5,054	5,466	5,381
Metal content	do.	3,369	3,644	3,587
Metal:				
Pig iron and sponge iron	do.	2,962	3,528	4,329
Ferroalloys	do.	98	93	152
Crude steel	do.	5,272	5,298	5,601
Steel semimanufactures	do.	r4,329	4,140	4,302
Lead:				
Mine output, metal content		178,615	200,027	163,479
Smelter (in refined and mixed bars)		172,928	189,731	153,948
Manganese ore:				
Gross weight[4]		428,459	453,211	486,623
Metal content		154,245	163,156	175,184
Mercury, mine output, metal content	76-pound flasks	14,214	15,026	9,660
Molybdenum, mine output, metal content		17	16	1
Nickel, mine output, metal content		50	56	34
Selenium, metallic		58	58	50
Silver:				
Mine output, metal content	thousand troy ounces	38,029	42,640	47,030
Metallurgical products, metal content	do.	36,599	40,215	43,913
Tin:				
Mine output, metal content		378	481	220
Smelter, primary[5]		1,000	800	800
Tungsten, mine output, metal content		277	235	191
Zinc:				
Mine output, metal content		288,851	259,183	265,469
Smelter, primary		153,959	175,210	174,376
NONMETALS				
Asbestos		26	1	--
Barite		299,985	270,063	270,674
Cement, hydraulic	thousand tons	11,612	12,584	13,227
Clays:				
Bentonite		32,507	55,583	59,169
Fuller's earth		38,197	20,108	61,369
Kaolin		120,440	71,350	87,589
Common		106,336	111,362	70,313
Diatomite		22,723	26,294	23,574
Feldspar		143,808	73,239	114,319
Fertilizer materials:				
Crude, phosphate rock		282,480	224,428	285,470
Manufactured:				
Nitrogenous, gross weight	thousand tons	r1,204	e r1,300	NA
Phosphatic, gross weight	do.	r546	507	NA
Mixed, gross weight	do.	313	NA	NA
Ammonia, anhydrous	do.	779	917	NA
Fluorspar, all grades	do.	1,089	1,004	955
Graphite, all grades		60,814	60,337	58,432
Gypsum and anhydrite, crude	thousand tons	1,256	1,414	1,496
Magnesite		39,523	23,186	3,528
Mica, all grades		620	1,303	771
Perlite		19,066	14,555	24,315
Salt, all types	thousand tons	5,354	4,591	4,900
Soda ash (sodium carbonate)	do.	r408	390	e420

See footnotes at end of table.

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Table 1.—Mexico: Production of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
NONMETALS —Continued			
Stone, sand and gravel:			
Calcite, common	7,634	4,902	8,784
Dolomite	348,749	347,007	433,429
Limestone[e] thousand tons	4,652	4,763	4,750
Marble	2,693	2,449	1,348
Quartz, quartzite and glass	518,973	509,029	626,715
Cobblestone	3,477	NA	NA
Strontium minerals	14,722	22,157	45,633
Sulfur, elemental:			
Frasch process thousand tons	2,074	2,054	1,723
Byproduct from metallurgy[e] do.	52	75	75
Byproduct from natural gas do.	90	96	133
Total do.	[r]2,216	2,225	1,931
Sulfates, natural sodium	300,121	228,025	109,489
Talc	1,480	192	163
Wollastonite	543	1,143	692
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	[r e]100,000	171,108	109,728
Coal, bituminous thousand tons	5,193	5,650	6,610
Coke:			
Metallurgical do.	2,058	2,151	2,411
Imperial do.	12	21	12
Breeze do.	18	16	14
Total do.	2,088	2,188	2,437
Gas:			
Manufactured, all types	[e]212,000	NA	NA
Natural:			
Gross production million cubic feet	786,469	771,774	746,863
Marketable production do.	583,885	577,934	602,917
Natural gas liquids:			
Field condensate thousand 42-gallon barrels	50	[r e]95	105
Other do.	32,665	34,154	38,136
Petroleum:			
Crude do.	261,540	267,320	357,985
Refinery products:			
Aviation gasoline do.	522	565	525
Other gasoline do.	66,504	76,366	83,924
Jet fuel do.	5,275	6,179	7,749
Kerosine do.	12,966	13,444	12,416
Distillate fuel oil do.	55,376	59,075	66,574
Residual fuel oil do.	65,441	78,217	85,122
Lubricants do.	3,024	3,103	2,813
Other:			
Liquefied petroleum gas do.	18,819	20,278	24,030
Asphalt do.	4,115	3,690	4,403
Unspecified do.	4,555	1,471	809
Refinery fuel and losses do.	11,380	11,405	12,871
Total do.	247,977	273,793	301,236

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, lime, pumice and additional types of crude construction materials are also produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2]Calculated white arsenic equivalent of metallic arsenic content of products reported.

[3]Calculated from reported iron content based on a grade of 66.67% iron.

[4]Calculated from reported metal content of mine production, based on a grade of 36% manganese.

[5]Estimate by the International Tin Council.

[6]Excluding that for cement production.

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TRADE

The value of total Mexican exports in 1977 was $4.1 billion, an increase of 24% over the revised 1976 value of $3.3 billion. Nonfuel mineral-related exports were $445 million, or 11% of the total 1977 exports. Silver, zinc, lead, sulfur, and fluorspar minerals and products were the principal contributors. Total petroleum products exports jumped to an estimated $1.02 billion in 1977 (a 134% gain over the 1976 value of $436 million) representing 25% of total exports. Crude oil accounted for 97% of the petroleum-related exports.

Although sales to the United States accounted for the major portion of petroleum exports, for the first time Mexico exported petroleum to Europe. PEMEX planned to continue market diversification, eventually expanding sales to include Europe, Japan, and Latin America.

The total value of 1977 Mexican imports was $5.49 billion, a decline of 9% from the 1976 level. Nonpetroleum-related mineral imports were valued at $285 million, compared with $226 million in 1976. Petroleum product imports for 1977 amounted to an estimated $208 million, a decrease of 9.5% from the 1976 estimate of $230 million.

Available data on mineral exports and imports are shown in tables 2-3.

Table 2.—Mexico: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976 [1]	Principal destinations, 1976
METALS			
Aluminum metal including alloys, all forms	--	4	All to Belize.
Antimony:			
Ore and concentrate, gross weight	8,288	6,115	United States 6,057; Guatemala 46.
Metal including alloys, all forms	275	190	United States 131; Brazil 58.
Arsenic, oxide, gross weight	3,255	4,718	United States 3,749; Brazil 854.
Bismuth:			
Ore and concentrate	--	4,466	Japan 4,448; United States 10.
Metal including alloys, all forms	405	304	Belgium-Luxembourg 113; United States 75; United Kingdom 64.
Cadmium:			
Concentrate and speiss, gross weight	--	10	All to United States.
Flue dust, metal content	369	288	United States 282; United Kingdom 6.
Metal	444	261	United States 113; Panama 63.
Copper:			
Ore and concentrate, gross weight	8,387	2,579	Belgium-Luxembourg 1,333; United States 1,246.
Copper sulfate	425	800	Brazil 703; United States 74; Guatemala 20.
Metal including alloys:			
Scrap	6	--	
Unwrought and semimanufactures	12,137	5,177	United States 2,450; Greece 1,499; Japan 1,199.
Iron and steel:			
Ore and concentrate, gross weight	13,843	11,542	Norway 8,000; United States 2,875.
Metal including alloys:			
Scrap	2,500	1,212	All to United States.
Pig iron, including cast iron	316	150	Do.
Sponge iron, powder and shot	--	470	Do.
Ferroalloys	182	--	
Steel, primary forms	2,339	140	Guatemala 115; United States 25.
Semimanufactures	75,807	8,640	United States 8,352.
Lead:			
Ore and concentrate, gross weight	454	7,434	United States 6,353.
Oxides:			
Litharge	24,643	29,348	United States 13,404; Venezuela 4,793.
Red lead	1,503	2,209	United States 735; Colombia 333; Brazil 290.
Metal including alloys:			
Scrap	131	22	All to Argentina.
Unwrought:			
Antimonial and other bars	3,352	9,116	Italy 4,670; United States 1,733; Yugoslavia 643.
Refined	97,955	56,354	United States 22,242; Italy 15,542; U.S.S.R. 5,958.
Semimanufactures	--	222	United States 86; United Kingdom 57; Canada 47.
Manganese ore and concentrate, gross weight	194,091	179,165	Japan 108,164; Norway 30,840; United States 23,285.
Mercury 76-pound flasks	11,504	8,615	Brazil 3,626; United States 3,481.
Selenium, elemental	42	44	United States 22; United Kingdom 14; Brazil 7.
Silver:			
Ore and concentrate	32,140	32,819	NA.
Metal thousand troy ounces	28,657	26,850	NA.

See footnotes at end of table.

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Table 2.—Mexico: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976[1]	Principal destinations, 1976
METALS —Continued			
Tin:			
Ore and concentrate	5,550	--	
Metal including alloys, all forms	(2)	--	
Titanium oxide	71	178	Ecuador 61; Peru 51; Chile 36.
Tungsten ore and concentrate, gross weight	3,053	NA	NA.
Zinc: Ore and concentrate, gross weight	103,257	153,476	Belgium-Luxembourg 83,133; Netherlands 21,456; United States 20,951.
Oxide white	6,908	9,949	United States 9,681; Canada 124.
Sulfate	3,060	5,359	United States 4,920; Canada 429.
Metal including alloys:			
Scrap	4,813	3	All to El Salvador.
Powder	8,645	8,302	All to United States.
Unwrought	86,471	123,260	United States 53,213; Brazil 32,424; Netherlands 10,204.
Other nonferrous base metals:			
Ores, concentrates, and metallurgical residues, except scrap	73	487	All to United States.
Metal, all forms	310	998	Brazil 807; Argentina 64; Netherlands 62.
NONMETALS			
Abrasives, natural, n.e.s.:			
Emery	1	1	Mainly to Guatemala and Dominican Republic.
Pumice	55	169	United States 168.
Asbestos	2	--	
Barite and witherite	113,675	106,728	Mainly to United States.
Clays and clay products:			
Crude clays, n.e.s.:			
Bentonite	56	6	El Salvador 5; United States 1.
Fuller's earth and other earths	11,011	12,696	Brazil 5,419; Colombia 1,188; Peru 1,474.
Kaolin (china clay)	31	10	All to Colombia.
Other	335	314	Guatemala 140; Peru 54; Colombia 46.
Diamond, industrial carats	140,000	--	
Diatomite and other infusorial earth	3,364	3,606	Argentina 2,108; Brazil 525; Peru 301.
Feldspar	40	54	Venezuela 50; United States 4.
Fertilizer materials, crude phosphatic	257	747	All to United States.
Fluorspar:			
Acid grade	360,765	262,977	United States 240,708; Canada 22,242.
Metallurgical grade	478,204	400,189	United States 346,644; Canada 46,287.
Graphite, natural	46,657	45,707	United States 45,677.
Gypsum:			
Crude thousand tons	585	1,087	United States 1,051.
Calcined do	16	33	Belgium-Luxembourg 26; United States 7.
Magnesite	--	15	Mainly to Guatemala.
Mica	51	45	All to United States.
Perlite	2,282	3,869	Brazil 1,689; Cuba 618; Colombia 443.
Precious and semiprecious stones, except diamond kilograms	4,728	5,026	United States 2,394; Japan 2,367.
Salt thousand tons	3,653	3,282	Japan 2,325; United States 701.
Sodium and potassium compounds:			
Sodium hydroxide	4,466	208	Argentina 197; Guatemala 11.
Sodium sulfate	117,273	119,308	Brazil 90,058; Venezuela 19,412.
Stone, sand and gravel:			
Dimension stone	--	1,694	Switzerland 819; United States 465; Italy 221.
Dolomite	--	370	Guatemala 270; El Salvador 100.
Gravel and crushed rock	--	4,666	All to United States.
Limestone, (except dimension)	2,121	NA	NA.
Quartz and quarzite	3,339	864	Do.
Sand:			
Construction	2,546	997	United States 801; Guatemala 76; El Salvador 74.
Glass	23,979	NA	NA.
Strontium minerals	15,028	NA	NA.
Sulfur, elemental, all forms thousand tons	1,368	1,020	United States 732; United Kingdom 134.
Talc	--	5	All to Honduras.
Vermiculite	551	311	All to United States.
Wollastonite	51	806	Mainly to United States.
Other nonmetals, n.e.s.:			
Crude	--	31,542	All to United States.
Oxides and hydroxides	--	2	Do.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	6	10	All to Spain.
Carbon black	2,213	964	United States 808; Venezuela 120.
Coal and coke	7	5	All to Venezuela.
Peat, including peat briquets and litter	17	--	
Petroleum:[3]			
Crude thousand 42-gallon barrels	38,311	44,145	NA.

See footnotes at end of table.

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Table 2.—Mexico: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976[1]	Principal destinations, 1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum[3] —Continued			
Refinery products:			
Gasoline thousand 42-gallon barrels	482	1,105	NA.
Distillate fuel oil do	47	100	NA.
Residual fuel oil do	1,380	172	NA.
Lubricants do	NA	--	
Other do	201	20	NA.
Total do	2,534	1,397	NA.

NA Not available.
[1]Data for 1976 is from Annuario Estadistico de la Mineria Mexicana, Consejo de Recursos Minerales, Mexico, D.F., 1977.
[2]Less than 1/2 unit.
[3]Data for 1976 is from International Petroleum Annual, 1976. U.S. Department of Energy, Washington, D.C., 1978.

Table 3.—Mexico: Imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976[2]	Principal sources, 1976
METALS			
Aluminum:			
Bauxite and concentrate	47,847	35,815	United States 24,575; Guyana 8,654.
Oxide and hydroxide	88,906	105,010	United States 104,360.
Metal including alloys, all forms	12,705	16,301	United States 15,572; France 516.
Arsenic trioxide, pentoxide, and acids kilograms	--	485	United States 450.
Bismuth metal including alloys, all forms do	29,244	191	United States 180.
Cadmium metal including alloys, all forms do	18,364	220	West Germany 165; United States 55.
Chromium, chromite	49,293	51,262	United States 44,261; Cuba 7,000.
Cobalt:			
Oxide and hydroxide	91	126	Belgium-Luxembourg 96; United States 15.
Metal including alloys, all forms	30	79	Belgium-Luxembourg 56; United States 23.
Copper metal including alloys:			
Scrap	287	533	All from United States.
Unwrought	64	10	United States 9.
Iron and steel:			
Ore and concentrate, gross weight	34,144	159	Australia 90; United States 68.
Metal:			
Scrap	1,163,743	522,904	Mainly from United States.
Pig iron, including cast iron	--	110,021	United States 75,716; Brazil 24,281; Algeria 10,000.
Sponge iron, powder, and shot	2,012	2,114	Mainly from United States.
Ferroalloys	11,181	--	
Steel, primary forms	122,321	49,795	United States 28,225; West Germany 8,041; Switzerland 6,505.
Semimanufactures	234,142	35,398	United States 24,040; Switzerland 7,381; Poland 1,482.
Lead metal including alloys, all forms	556	509	All from United States.
Magnesium metal including alloys, all forms	911	2,050	United States 1,845; Norway 179.
Manganese:			
Ore and concentrate	1,165	17,037	France 10,539; United States 6,498.
Oxides	681	860	United States 624; Japan 144.
Molybdenum:			
Ore and concentrate	--	589	All from United States.
Metal including alloys, all forms	14	19	Do.
Nickel:			
Matte, speiss, similar materials	2,659	1,428	United States 985; Canada 197; France 137.
Metal including alloys, all forms	529	690	United States 584; France 61.
Platinum-group metals, all forms:			
Palladium troy ounces	1,259	689	NA.
Platinum do	1	31	All from Switzerland.
Other do	--	125	Mainly from United States.
Silver metal including alloys, all forms	--	5	NA.
Tin:			
Ore and concentrate, gross weight	3,240	2,162	United States 793; Bolivia 330; Singapore 298; Chile 284.
Metal including alloys, all forms	--	57	All from United States.
Oxides	40	51	United States 38; West Germany 6.

See footnotes at end of table.

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Table 3.—Mexico: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976[2]	Principal sources, 1976
METALS —Continued			
Titanium:			
Ore and concentrate, gross weight	212	1,977	Australia 1,567; United States 410.
Ilmenite	--	23,378	Mainly from Australia.
Slag and residues	7,477	24,414	Mainly from Canada.
Tungsten metal including alloys, all forms	329	28	Mainly from United States.
Vanadium oxides	554	128	Do.
Zinc:			
Oxides	334	247	Do.
Metal including alloys, all forms	65	58	Do.
Other:			
Oxides, hydroxides, peroxides of metals, n.e.s	235	369	United States 301.
Metals including alloys, all forms:			
Metalloids:			
Phosphorous, elemental	21,711	12,634	Mainly from United States.
Silicon	622	633	United States 256; Brazil 135; United Kingdom 120; Sweden 100.
NONMETALS			
Abrasives, natural, n.e.s	67	250	United States 217; West Germany 27.
Asbestos	60,981	54,019	Canada 29,649; United States 11,436; Italy 9,945.
Barite and witherite	90	321	All from United States.
Boron materials:			
Crude natural borates	14	94	United States 51; Argentina 40.
Oxide and acid	1,784	1,711	Mainly from United States.
Calcium carbonate, precipitates	--	1,767	United States 1,022.
Clays and clay products (including all refractory brick):			
Kaolin (china clay)	32,574	39,598	Mainly from United States.
Refractory	48,989	134,313	Do.
Cryolite and chiolite	(3)	1	Mainly from Switzerland and United States.
Diamond, all grades carats	--	17	Venezuela 12; Belgium-Luxembourg 4.
Diatomite	344	270	All from United States.
Feldspar	2,259	1,416	Mainly from United States.
Fertilizer materials:			
Crude:			
Nitrogenous	6,650	--	
Phosphate rock thousand tons	791	173	United States 128; Morocco 45.
Manufactured:			
Potassic	110,700	129,667	United States 112,419; Spain 16,850.
Other, including mixed	--	1,500	All from Chile.
Fluorspar	(3)	--	
Graphite, natural	1,256	176	Mainly from United States.
Gypsum	22,938	22,251	Do.
Magnesite	8,957	15,034	United States 10,501; Japan 4,528.
Mica:			
Crude, including splittings and waste	30	203	Argentina 131; Brazil 54.
Worked, including agglomerated splittings	26	27	United States 24; West Germany 2.
Precious and semiprecious stones, except diamond	919	513	All from United States.
Pyrite, gross weight	--	281	Do.
Salt	846	1,548	Mainly from United States.
Sodium and potassium compounds:			
Caustic soda	58,376	70,154	Mainly from United States.
Caustic potash, soda and potassic peroxides	514	1,916	United States 1,119; Denmark 335; West Germany 310.
Stone, sand and gravel:			
Dimension stone, crude and partly worked	--	3,380	Italy 1,966; Guatemala 944; United States 240.
Quartz and quartzite	1,839	844	United States 437; Switzerland 260; Sweden 104.
Sand, excluding metal bearing	272,669	225,895	Mainly from United States.
Sulfur, elemental, all forms	421	756	All from United States.
Talc, steatite, soapstone, and pyrophyllite:			
Pyrophyllite	46	--	
Steatite	88,463	109,641	Mainly from United States.
Talc	320	386	United States 286; Italy 100.
Vermiculite	2,216	834	All from United States.
Other nonmetals, oxides and hydroxides of magnesium, strontium, and barium	--	301	Mainly from United States.
MINERAL FUELS AMD RELATED MATERIALS			
Carbon black and gas carbon:			
Carbon black	514	1,808	Mainly from United States.
Gas carbon	3	273	All from United States.
Coal, all grades, including briquets	450,345	91,458	Mainly from United States.
Coke and semicoke	113,010	96,045	United States 78,629; Japan 16,495.
Peat, including peat briquets and litter	245	91	All from United States.

See footnotes at end of table.

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Table 3.—Mexico: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976[2]	Principal sources, 1976
MINERAL FUELS AMD RELATED MATERIALS —Continued			
Petroleum, refinery products:[4]			
Gasoline ------ thousand 42-gallon barrels	6,580	4,441	NA.
Kerosine ------ do	186	213	NA.
Distillate fuel oil ------ do	3,741	4,765	NA.
Residual fuel oil ------ do	7,388	5,408	NA.
Lubricants ------ do	411	187	NA.
Other ------ do	4,640	[5]3,863	NA.
Total ------ do	22,946	18,877	

NA Not available.

[1]Includes free trade materials in totals and in principal sources.

[2]Data for 1976 is from Anuario Estadistico de la Mineria Mexicana, Consejo de Recursos Minerales Mexico, D.F., 1976, 1977.

[3]Less than 1/2 unit.

[4]Data for 1976 is from International Petroleum Annual, 1976. U.S. Department of Energy, Washington, D.C., 1978.

[5]Includes 1,165 barrels of pitch and 850 barrels of petroleum coke.

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COMMODITY REVIEW

METALS

Aluminum.—Construction was delayed on the Jalumex aluminum smelter, a joint Mexican-Jamaican endeavor to be located near Vera Cruz. In November 1977, the two countries reached an agreement on the pricing formula for the alumina that is to be supplied by the planned Javemex plant in Jamaica. Financing arrangements appeared to be a possible deterrent to finalization of the project.

Aluminio, S.A. de C.V. remained Mexico's only primary aluminum producer. Plant expansion work was completed in 1977, doubling capacity to 90,000 tons per year.

Copper.—Certainly the most publicized mineral undertaking in Mexico has been the La Caridad open pit porphyry copper mine, smelter, and refinery complex. With a capacity of 100,000 tons per year of metal, La Caridad will be one of the largest copper mines in the world and will more than double Mexico's copper production capacity. Controlled by Mexicana de Cobre, S.A., owned 44% by the Government, the ultimate cost of the project, including the smelter and refinery, has been estimated at more than $900 million. By mid-1977 there were 6,000 people employed on the project, 48 million tons of waste had been stripped, and 5 million tons of leach-grade ore stockpiled. The mine development has fallen behind schedule with startup now not expected until late 1978 or early 1979. The smelter site has been changed from Empalme on the Gulf of California to a location nearer the mine and close to the Nacozari to Bisbee railroad. The deposit is located in the State of Sonora about 20 kilometers southeast of Nacozari de García. It has been estimated to contain 660 million tons of proven ore reserves assaying 0.67% copper and 0.02% molybdenum. The molybdenum sulfide is primarily concentrated in the eastern half of the deposit where it can average as high as 0.37% molybdenum while the western half drops to about 0.01%. A 100-ton-per-day pilot plant operation was maintained throughout 1977 to confirm the metallurgy, train personnel, and determine a molybdenum flowsheet. Favorable market outlook projections for molybdenum may hasten recovery plans which are not presently intended to begin for several years.

Despite the general enthusiasm for Mexico's copper prospects, the depressed world copper market and some difficulty in securing sufficient Mexican participation to meet the 51% local equity requirement, prompted Lytton Minerals Ltd. of Canada to withdraw from its 48% participation in Cía. Minera Cuprifera La Verde, S.A.'s La Verde mine project in the State of Michoacán. The property has reverted to the Government.

The Government, through the Comisión de Fomento Minero, acquired operating majority in the Cía. Minera de Cananea's open pit copper mine in Sonora. Federal and private Mexican interests now hold 66% of the shares while the Anaconda Company, now a subsidiary of Atlantic Richfield Co., retained 34%. Expansion of mine and smelter capacity to 70,000 tons per year of copper was completed in early 1977. A further increase to 100,000 tons per year was under study.

Iron and Steel.—Exploration activities pursued by the major mining companies have increased total iron ore reserve estimates to 200 million tons grading 60% iron in northern Mexico and 311 million tons grading 55% iron in the southern part of Mexico.

Strikes, shortages of raw materials, and operational difficulties reduced crude steel production to about 60% of the 9 million tons per year total capacity. Even this unsatisfactory production level represented a 5.7% improvement over 1976 level. An encouraging development was the changing proportion in the amount of crude steel

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produced by different processes. The basic oxygen furnace process (BOP) accounted for 27% of 1977 production. Production from the electric arc method (44%) also increased while that from the less efficient open-hearth method (29%) declined. Ferroalloys output was the most active sector among primary products with a 63% increase over 1976 production. Mexico's five integrated steelplants produced 85% of the total finished steel production. The following shows a comparison of primary product and crude steel production from 1975 to 1977, in thousand tons:

	1975	1976	1977
Primary products:			
Ferroalloys	98	93	152
Pig iron	2,048	2,413	3,009
Sponge iron	914	1,115	1,320
Crude steel:			
Open hearth	2,185	2,154	1,628
Electric furnace	2,400	2,441	2,470
BOP	687	703	1,504
Total[1]	5,272	5,298	5,601

[1]Data may not add to totals shown because of independent rounding.

In 1977, the Government acquired a 44% controlling interest in Fundidora de Monterrey, S.A., and thereby established majority ownership in three of Mexico's five integrated steel complexes. Eventually all three plants, Fundidora, Altos Hornos de México, S.A. (AHMSA), and Siderúrgica Lázaro Cárdenas Las Truchas, S.A. (SICARTSA), will probably be merged into a single holding company, Sidermex.

For the most part the large Mexican steel companies have not fared well financially. Only HYSLA (formerly Hojalata y Lámina, S.A.) escaped the various difficulties suffered by the other four major companies.

Higher infrastructure costs resulting from the devaluation of the Mexican peso were partially responsible for expansion postponements at the SICARTSA complex, which operated at 20% of capacity in 1977. Another serious consideration was the substantial downward revision of reserves at the nearby Las Truchas iron ore deposit from 130 million to 70 million tons and the now questionable dependability of a continued supply for sufficient years to justify the cost factors.

The following tabulation gives 1977 production, current capacity, and the projected capacity of Mexico's major steel companies, in thousand tons:

Company	1977		1981 capacity
	Production	Capacity	
AHMSA (Altos Hornos de México, S.A.)	2,197	3,200	4,200
HYSLA (Hojalata y Lámina, S.A.)	1,271	1,545	2,300
Fundidora de Monterry, S.A	671	1,500	1,870
TAMSA (Tubos de Acero de México, S.A.)	367	425	745
SICARTSA (Siderúrgica Lázaro Cárdenas Las Truchas, S.A.)	263	1,300	1,450
Nonintegrated plants (26 plants)	832	1,060	1,150
Total	5,601	9,030	11,715

Lead and Zinc.—Production of lead and zinc ore continued to outstrip refining capacity. The three operating refineries have a combined zinc metal capacity of 171,000 tons per year. Low prices and reduced world demand could slow down the electrolytic zinc smelter construction by Industria Minera Mexico, S.A. (IMM), at San Luis Potosí. Operational problems were corrected at the Industria Peñoles, S.A. smelter at Torreón and output approached 90% of installed capacity at the end of the year. By 1981 Mexico's total zinc metal refining capacity should reach 322,000 tons per year, bringing mine output and refinery capacity into balance.

At the end of 1977 persistent poor world market conditions prompted U.S. zinc producers to petition the U.S. International Trade Commission to limit total metallic zinc imports subject to the present 0.7 cent per pound import tax to 350,000 short tons. It was further petitioned that amounts over 350,000 short tons be taxed at 7 cents per pound. Since the United States is the major single market for Mexican zinc exports, the Mexican Government was expected to submit counter petitions to the ITC emphasiz-

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ing the grave consequences of these proposed import restrictions and their punitive effect on Mexico's traditional market sales to the United States. Fortunately, those minerals produced in association with zinc, particularly silver, experienced favorable market conditions and rising prices, countering the adverse zinc market and providing a stimulus to productivity.

During the last 4 years Industria Minera México, S.A. has substantially increased production at its three major mines. Santa Barbara in Chihuahua, one of the largest underground mines in Mexico produces gold, copper, lead, and zinc. The mine has a capacity of 2,400 tons of ore per day. At the San Martín mine in the State of Zacatecas, silver, copper, and zinc ore was produced at the rate of 1,350 tons per day and by 1980 output should double. At Taxco, in Guerrero, mine capacity has increased to 300,000 tons per year. These three mines along with additional production from the Plomosas and Santa Eulalia mines accounted for the major portion of zinc production in Mexico. Peñoles installed a flotation plant at the Encantada mine and when fully operational the mill will have a full capacity of 400,000 tons per year of lead-silver ore. Lacana Mining Corp. is a partner in the project.

Manganese.—Cía. Minera Autlán, S.A., increased output from its underground and open pit mines in the State of Hidalgo northeast of Mexico City. The company contributed at least 90% of total Mexican manganese production, having produced 437,084 tons of ore in 1977, a 17% increase over 1976. About 46% of this production was sold for domestic consumption. The company's output is primarily in the form of a calcined nodulized ore with the manganese and iron contents in their lowest valence form of manganese oxide and iron oxide. Minera Autlán is a vertically integrated company and, as such, is also a major producer of ferroalloys. In 1977, the company provided about 65% of the country's ferromanganese requirements. Mexico's proved reserves of manganese were estimated at 62 million tons of metal content.

Silver.—Mexico maintained a comfortable lead as the principal world producer of silver with 1977 production exceeding 47 million ounces. Industrias Peñoles, S.A., continued to account for the major portion of the production having refined about 31.3 million ounces in 1977.

Rosario Resources Corp., which already owned 40% of Cía. Fresnillo, S.A., announced plans to merge Fresnillo into Rosario by offering Rosario stock for Fresnillo common stock. Fresnillo's largest operation was at Naica in the State of Chihuahua where mill capacity should reach 2,400 tons of ore per day in 1978. The Naica mine has replaced the older Fresnillo mine in the State of Zacatecas as the company's largest and most profitable operation. It was reported that new ore bodies have been found at the old Fresnillo mines, some of which date back to colonial times. Veins from 3 to 4 meters in width and grading from 30 to 90 ounces of silver per ton were reported and, subject to further verification, would revitalize the area's mining activity.

Cía. Minera Las Torres, S.A., owned jointly by Peñoles (33%), Fresnillo (37%), and Lacana Mining Corp. (30%), operated the four underground silver-gold mines at Guanajuato. The mines, Cedros, Peregrina, Cebada, and Bolanitos, have approached capacity operation and have an estimated 3 million tons of reserves grading an average 10.5 ounces of silver and 0.06 ounce of gold per ton. Two of these mines have an expected life of about 6 more years. Las Torres has been actively exploring the Guanajuato area for additional deposits.

The flotation plant at Peñoles and Lacana's two Encantada mines in Coahuila was completed in mid-1977 and by October was in full production, at which time the old magnetic separation unit was shut down. A total of 248,000 tons of ore was treated at grades of 12.9% lead and 10.4 ounces of silver per ton.

The Comisión de Fomento Minero, the State mining holding company, joined with Placer Development Ltd. of Canada to develop by open pit the low-grade silver, lead, and zinc deposits at Real de Ángeles in Zacatecas. Proven ore reserves were estimated at 39 million tons grading 2.51 troy ounces of silver, 1.1% lead, and 1.05% zinc per ton.

Minera Frisco, S.A. de C.V. initiated production at the long idle Lampazos mine in the State of Sonora. The company found large tonnages of silver ore in structures parallel to those previously worked. Ore production in 1977 was about 150,000 tons, with increases planned to double this output.

NONMETALS

Cement.—The export market rather than domestic consumption continued to encourage expansion activities in the cement in-

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dustry. During 1977 the Government was slow in authorizing new construction and the private sector exhibited a reluctance to invest in building, particularly housing. Nevertheless, the major companies planned to increase their annual production by expanding various plant capacities. The Government predicted that total annual cement production will reach 20 million tons by 1982.

Fluorspar.—The continued depression in the world steel industry, discontinued use of fluorine as an aerosol propellant, increased foreign competition for available markets and comparatively high sale prices for Mexican fluorspar products all combined to adversely affect that country's fluorspar industry.

Exports to the United States fell as consumers there took advantage of cheaper fluorspar available elsewhere. Many small Mexican producers were obliged to cease production and larger producers operated well below capacity. Producer stockpiles were estimated to be equivalent to about 5 month's production. The Mexican Fluorite Institute was influential in maintaining price levels, preventing what could have become a price-cutting war as producers vied for sales advantage. By yearend it became problematic that the institute would advocate some price reductions in view of the world market and in response to local producer pressure as they actively seek to compete for overseas markets.

Mexico's increased hydrofluoric acid production and internal sales have somewhat compensated for the reduced acidspar export market. Total fluorspar reserves were estimated at over 37 million tons (on a 35% calcium fluoride basis) and equalled almost 20% of total known world reserves.

Graphite.—Mexico led the market economy countries in the production of graphite in 1977. Production in 1977 amounted to 58,432 tons, a 3% decline from the 60,337 tons produced in 1976. About 78% of the total graphite production was exported almost exclusively to the United States. Mexico provided 72% of total U.S. graphite imports.

Mexican graphite deposits occur principally in the State of Sonora near La Colorada and Guaymas. The reserves are large and of the amorphous type containing 80% to 93% carbon. The principal producers in Sonora are Cía.Minera Moraguirre, S.A. de C.V., with a production capacity of 30 tons per day; Grafitos Industrializados, S. A. de C.V., capacity 18 tons per day; and Grafito Superior, S.A., capacity 10 tons per day. Some graphite in association with other minerals is produced in the State of Puebla by Minerales La Cruz del Sur, S.A.

Phosphate Rock.—Roca Fosforica Mexicana S.A. (ROFOMEX) installed a small 25-ton-per-day semipilot plant at the site of the large phosphate deposit in southern Baja California. Experimental mining to determine the most effective methods of ore extraction was underway. Initial development will be in the San Juan de la Costa region where reserves were estimated at 160 million tons grading about 20% P_2O_5. The reserves extend inland to the Sierras. Industrial production is scheduled for 1979, and the eventual annual production of 1.6 million tons of rock will yield about 700,000 tons of 30% to 32% P_2O_5 concentrate. Production is primarily destined for domestic fertilizer manufacture with export market considerations of secondary importance. Exploration in the San Hilario area proved reserves totaling 630 million tons but the nature of the phosphate rock prohibits low cost beneficiation and development there has been suspended.

Sulfur.—Sulfur production decreased to about 1.9 million tons during 1977. Domestic consumption was down but exports at 1 million tons were at about the same level as in 1976.

MINERAL FUELS

Coal.—Industrial Minera Mexico opened a new coal mine in the State of Coahuila in northern Mexico. The company anticipated that another mine would start operations in 1978. All of the 6.6 million tons of coal production came from the State of Coahulia and represented an increase of about 1 million tons over 1976 production. The Camara Minera de Mexico estimated proven, in place coal reserves at 1.1 billion tons, of which approximately 770 million tons was claimed to be of coking quality. These reserves should satisfy the needs of Mexico's domestic steel industry until the end of this century.

Petroleum.—A tone of optimism and confidence in the future pervaded reports describing activities of the petroleum sector during 1977. This optimism is justly based on the continued success of PEMEX's exploration and development program in extending known and discovering new petroleum and natural gas fields. Although petroleum accounted for only 3.9% of the GDP in 1977, it certainly represented the major

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growth industry, with production of crude oil, condensate, and natural gas liquids 21.4% above that for 1976.

Reserves estimates were again officially increased. Proven reserves, including oil, gas liquids, and natural gas equivalents, were placed at 16 billion barrels; probable reserves at 31 billion barrels; and possible reserves (including proven and probable) at 120 billion barrels.

Proven hydrocarbon reserves for 1976-77 by producing zone, in thousands of barrels and millions of cubic feet, are shown in the following tabulation:

Zone	Dry natural gas (million cubic feet)	Petroleum (thousand 42-gallon barrels)				
		Crude	Condensate	Dry natural gas liquids equivalent	Total 1977[1]	Total 1976
Northern	11,260,226	543,221	277,584	2,252,047	3,072,848	2,352,579
Angostura	814,248	100,760	45,265	162,848	308,870	254,890
Poza Rica	2,833,441	1,609,238	131,527	566,685	2,307,455	2,358,731
Southern	12,960,339	6,832,509	887,872	2,592,071	10,312,455	6,194,688
Total 1977	27,868,254	9,085,728	1,342,248	5,573,651	16,001,628	XX
Total 1976	19,409,864	6,435,681	843,232	3,881,974	XX	[1]11,160,888

XX Not applicable.
[1]Data may not add to totals shown because of independent rounding.

Source: Petróleos Mexicanos, Memoria de Labores, 1977. Pp. 77-78.

Exploration activities in the Reforma region continued to reveal additional data on field stratigraphic and structural relationships and established production boundaries were extended. The southern production boundary was placed 20 miles south of the Sabancuy field and the western boundary was set at Paradon, 20 miles west of the former limit at the Grijalva River. Exploration work in the Campeche Bay revealed the possibility that this area may represent extensions of the onshore Reforma fields, and should they prove as prolific as the onshore portion of the region appears to be, production and reserves would be significantly increased.

Not to be overshadowed by activity in the Reforma area was the discovery of commercial gas fields in the Sabinas Basin in the States of Coahuila and Nuevo León. Prior to this find, commercial quantities of gas were only available from the gulf coast. Four fields, the Lampazos, Monclova, Travertino, and Bueno Suerte, were under production and another, the Uluna, was being tested.

Along the central part of the gulf coastal area, explorations around Pozo Rica, Cerro Azul, and Cotaxtla have extended the productive areas of these regions.

To the west, in Baja California, exploration continued in the Vizcaino desert. Some gas was reported but no official acknowledgement was made of a commercial discovery. One well drilled offshore was reported as showing traces of oil.

For the first time in over a decade Mexico resorted to using foreign drilling rigs and crews. Six drillships, three operated by Pemex and one each by Protexa, Interocean Drilling, and Sedco, Inc., operated in the Campeche Bay. Another drillship, operated by J. L. Offshore Drilling, worked offshore Baja California. Some onshore drilling was done by Mexican companies operating under contract to PEMEX. Only offshore drilling was contracted to foreign companies and this was evidently in response to Mexico's intense exploration program and a shortage of sufficient equipment and skilled workers to accommodate scheduled work. Efficiency also dictated the 1977 contracting of foreign expertise to manage the development of the Campeche oilfields. This shortage of rigs may thwart Mexico's intense drilling program. In 1977 only 307 wells were drilled, compared with 336 during 1976. Additional Mexican companies were contracted to drill onshore in 1978, and PEMEX expected to have about 202 rigs working, including 170 of their own.

A remarkable 38% success rate resulted from drilling 79 exploration wells in 1977. The exploration work identified 26 new fields when 17 wells found oil and 9 encountered natural gas. Four wells resulted in extensions of existing fields. Of the 79 exploratory wells, 72 were located onshore, 5 offshore, and 2 in inland waters; 62 represented wildcat drilling, 11 attempted extensions, and 6 were designated as strati-

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graphic tests. The 79 exploration wells resulted in an average of 10,609 feet drilled per well.

Developmental drilling activities found 125 oil wells and 51 gas wells; an impressive 77% success ratio as 176 out of 228 attempts were productive. Development was undertaken in 59 fields (1 offshore). The Reforma region received the most attention with 26 fields under development. In the Reynosa area near Monterrey 16 fields were drilled, while 12 fields in the Ebano and Cerro Azul area were drilled, and 5 field expansions were attempted in the Poza Rica and Papaloapan areas. Of the 228 attempts, 214 were conducted onshore, 4 offshore, and 10 in inland waters. The 228 development wells averaged 9,506 feet per well.

Crude oil, condensate, and natural gas liquid production averaged 1.1 million barrels per day during 1977, a 22% increase over 1976. The southern zone provided almost 80% of this production while the Poza Rica and northern Mexico areas accounted for 13% and 7%, respectively. Natural gas production decreased from 1976 because wells were shut-in while awaiting the completion of transportation and sweetening facilities. Associated and dissolved gas accounted for 58% of total gas production. Mexico's southern production zone provided the major portion of gas production 69%, the Northern zone 23%, and the Poza Rica zone almost 8%.

Total petroleum and natural gas production during 1977, by region, is shown in the following tabulation, in thousands of barrels and in millions of cubic feet:

Region	Natural gas (million cubic feet)	Petroleum (thousand 42-gallon barrels)		
		Crude	Condensate	Natural gas liquids
Northern Zone:				
Northeastern Frontier	147,350	425	18	3,759
Northern	20,805	16,202	--	248
Southern	4,964	7,972	--	--
Total	173,119	24,599	18	4,007
Poza Rica:				
Poza Rica	43,289	[1]45,357	--	NA
New Golden Lane	4,197	--	--	NA
Papaloapan Basin	9,198	907	15	--
Total	56,684	46,264	15	5,808
Southern Zone:				
Aqua Dulce	27,083	23,867	--	NA
Ciudad Pemex	161,878	140	--	NA
Comalcalco:				
Tertiary	12,812	12,950	--	NA
Cretaceous	299,483	236,232	73	NA
El Plan	14,490	11,512	--	NA
Nanchital	1,314	2,423	--	NA
Total	517,060	287,124	73	28,321
Total[2]	746,863	357,985	105	38,136

NA Not available.
[1]Includes 40,172,000 barrels of light crude and 5,185,000 barrels of heavy crude.
[2]Data may not add to totals shown because of independent rounding.

Source: Petróleos Mexicanos, Memoria de Labores, 1977. Pp. 74-76.

The five major and two minor refineries operated by PEMEX refined an average of 835,550 barrels of products per day, an increase of almost 13% over 1976. General refinery expansion programs and the construction of at least five new refineries were underway, two of which were scheduled to come onstream in 1978 and one in 1979.

Several pipeline projects were completed during 1977. The more important of these were the system linking refinery and petrochemical complexes at Minatitlan-Cosoleacaque with the new port facility at Pajaritos and the completion of two 18-kilometer lengths of 18-inch pipe between Poza Rica and Mexico City.

Certainly the largest and most publicized pipeline project was the approximately 1,344 kilometers (835 miles) of line under construction between the Reforma fields in the Chiapas region and the Reynosa-Monterrey area. The line will consist of 48-inch pipe from Chiapas to San Fernando and then of 42-inch pipe to Monterrey

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where it is anticipated 800 million cubic feet of gas per day will be delivered under natural pressure. Original plans included the construction of a 42-inch branch line from San Fernando to McAllen, Tex., to fullfill a proposed contract with six U.S. pipeline companies who had negotiated to purchase 2 billion cubic feet of natural gas per day. This phase of construction has been delayed pending U.S. Government approval of the proposed contract. The cost of the gas aroused considerable controversy and the year ended without an acceptable agreement being reached.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Mexican pesos (MEX$) to U.S. dollars at the rate of MEX$20.58=US$1 for 1977 and MEX$15.44=US$1 for 1976.

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The Mineral Industry of Morocco

By Janice L. W. Jolly[1]

The value of mineral production, excluding cement, natural gas, and petroleum products, contributed 7.2% to the gross national product (GNP) in 1977. Valued at $9.5 billion[2] at current prices, the GNP showed a real growth of 0.4% over that of 1976. At yearend, however, the Government was to present its 1978 budget as an "austerity" budget, a result of unrealistic expectations for high levels of phosphate earnings, which for the second straight year did not materialize. Contributing to the drop in mineral revenues was a further decline in demand in the vital European market for Morocco's exports of phosphate, iron ore, copper, and zinc. Partly as a result of these factors, Morocco's traditional trade deficit increased from $1.34 billion in 1976 to a record high of $1.78 billion in 1977.[3] The planned 1978 budget reflected lower planned investment levels and a conscious effort by the Government to come to terms with the country's current economic difficulties. An effort was to be made to reduce the trade deficit as well as to increase fiscal revenues through new taxes.

The Moroccan Investment Code continued to offer inducements to firms willing to accord local partners at least half ownership plus board chairmanship. In such priority sectors as mining and export industries, 100% foreign ownership was authorized while still permitting foreign firms to profit from Code incentives.[4]

The principal Moroccan Government minerals offices included the following: (1) Office Chérifien des Phosphates (OCP), which had been owned by the Government since 1920 and had a complete monopoly on production, exploration, and transportation of phosphate; (2) Bureau de Recherches et de Participations Minières (BRPM), which was the Government's mining investment and research organization for minerals other than phosphate, and had the status of a private corporation; and (3) Direccion des Mines, de la Géologie et de l'Énergie, which was the Government's legal, research, and recording agency for minerals. Plans for investment of capital in mining enterprises were the responsibility of the Directorate of Mines. The Directorate issued mining research and exploitation permits and was under the Ministere du Commerce, de l'Industrie, des Mines et de la Marine Marchande.

PRODUCTION AND TRADE

Mineral production, excluding petroleum, natural gas, and cement, was valued at $680.5 million in 1977. Phosphate rock accounted for 85% of the total value received. Lead concentrate ($44.3 million), manganese ore ($8.8 million), iron ore ($7.5 million), and cobalt concentrate ($6.3 million) were the leading revenue earners after phosphate rock.

Phosphate rock production rose 12% to 17.6 million tons in 1977. Phosphate rock exports were up 1.1 million tons compared with those of 1976, but despite the tonnage increase, earnings from phosphate rock fell in 1977 to $536 million. Phosphate rock was valued at less than $35 per ton, compared with the $68 per ton price set by OCP at the height of the world phosphate boom in January 1975. The increase in phosphate rock exports was largely because Spain

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almost doubled its intake of 2.6 million tons. Exports to France and Belgium also increased.[5] The first major arrangement for supply of Moroccan phosphate to the United States was made with the U.S. fertilizer company, Beker Industries. Exports to the United States were expected to increase. OCP also planned on increasing exports to Mexico through a barter deal with Fertilizantes Mexicanos S.A. (FERMEX), in which Mexican sulfur, ammonia, and cement would be exchanged for Moroccan phosphate rock. Phosphoric acid sales were predominantly to Western Europe (57%), India (19%), Brazil (17.7%), and Eastern Europe (6.4%). OCP also purchased over 160,000 tons of phosphoric acid (P_2O_5) for resale from producers in France and Spain, in an effort to enhance markets for expected increased Moroccan capacity scheduled to come onstream.

Exports totaling 25,145 tons of Bu Craa phosphate rock were resumed from El Aaiún in the fourth quarter of 1977 and went to Spain and Uruguay. Shipments from Bu Craa in 1976 totaled 277,000 tons and consisted mostly of beneficiated material from stocks. Phosphate rock concentrate stocks at El Aaiún were reported to be 206,000 tons on December 31, 1977. The conveyor belt between the mine at Bu Craa and El Aaiún was still out of action, but the company was expecting the 1978 production to increase.[6]

Iron ore exports were down for the second year, caused by the recession in the European iron and steel industry. The drop in iron ore sales, which occurred in the second quarter of 1977, brought about the near-closing of the mines at Nador. Some copper mines also reportedly closed because of low world market prices. Because of the low metallic content of the cobalt ores mined at Bou Azzer and because operations at Tamdrost were still in initial stages, cobalt production was down 49% in 1976 and increased only marginally in 1977. Because of a rise in price, however, cobalt revenues increased. The metal content of Morocco's 1977 cobalt production accounted for 5.3% of the world's total cobalt production.[7]

Morocco petroleum production increased to 22,100 tons in 1977 compared with 8,100 tons produced in 1976. About 90 million cubic meters of natural gas were produced for commercial use in 1977 compared with 80 million cubic meters for 1976. Imports of crude oil from the U.S.S.R. (about 600,000 tons per year) were expected to show a rapid increase from 1980 onward as a result of the barter agreement between the two countries for the development of the Meskala phosphate deposit. Imports of crude oil totaled 2.9 million tons in 1977 and came mostly from Iraq (56%), the U.S.S.R. (23.6%), Saudi Arabia (16.8%), and Iran (3.6%). Distillate fuel oil imports were 389,000 tons.

Table 1.—Morocco: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Antimony concentrate:			
Gross weight	2,770	3,723	3,355
Metal content	1,191	1,675	1,409
Cobalt concentrate:			
Gross weight	14,007	7,185	7,805
Metal content	1,821	934	1,561
Copper concentrate:			
Gross weight	17,970	16,380	12,112
Metal content	4,852	[e]4,914	4,845
Iron and steel:			
Iron ore, direct shipping, gross weight	554,156	342,763	407,368
Pig iron[e]	10,000	10,000	12,000
Steel[e]	1,000	1,000	--
Lead:			
Concentrate:			
Gross weight	104,327	98,686	155,685
Metal content	63,639	60,198	93,411
Smelter, primary	7,900	26,380	33,136
Manganese ore, chemical grade	130,947	117,304	113,547
Nickel content of cobalt ore[e]	280	143	156
Silver, mine output, metal content thousand troy ounces	2,894	1,040	946
Zinc concentrate:			
Gross weight	36,131	29,568	22,153
Metal content	20,956	17,740	7,754

See footnotes at end of table.

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Table 1.—Morocco: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
NONMETALS			
Barite	128,770	129,215	149,920
Cement, hydraulic thousand tons	2,235	2,324	2,870
Clays, crude:			
Bentonite	3,051	4,664	4,807
Smectite	23,720	36,768	21,025
Other, including fuller's earth	5,893	3,768	NA
Fertilizer materials, crude, natural phosphate rock thousand tons	13,548	15,656	17,572
Fluorspar	47,421	51,450	40,000
Goethite	47	14	88
Mineral water cubic meters	22,994	28,064	24,213
Pyrite and pyrrhotite:			
Gross weight	203,789	76,242	149,972
Sulfur content	66,231	[e]22,870	44,992
Salt, all types	60,000	21,430	12,442
MINERAL FUELS AND RELATED MATERIALS			
Coal, anthracite thousand tons	652	702	707
Fuel briquets do	[e]6,000	[2]9,960	7,962
Gas, natural:			
Gross production million cubic feet	2,501	1,730	3,037
Marketed do	[e]2,000	[e]1,500	3,002
Petroleum:			
Crude oil thousand 42-gallon barrels	171	62	167
Refinery products:			
Gasoline do	3,123	3,177	3,411
Jet fuel do	983	594	1,788
Kerosine do	754	1,050	NA
Distillate fuel oil do	4,875	5,506	5,200
Residual fuel oil do	7,114	7,524	8,358
Other do	1,267	1,499	1,070
Refinery fuel and losses do	1,157	1,331	1,160
Total do	19,273	20,681	20,987

[e]Estimate. [p]Preliminary. NA Not available.

[1]In addition to the commodities listed, Morocco also produces manufactured phosphate fertilizers and a variety of crude construction materials but available information is inadequate to make reliable estimates of output levels.

[2]Sales.

Table 2.—Morocco: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal including alloys, all forms	458	763	West Germany 312; Italy 125; France 117.
Antimony, ore and concentrate	3,102	3,795	United Kingdom 1,413; Yugoslavia 841; France 523.
Cobalt, ore and concentrate	13,144	8,550	All to France.
Copper:			
Ore and concentrate	8,511	22,700	West Germany 6,344; U.S.S.R. 5,218; Romania 4,352.
Metal including alloys, all forms	354	1,557	France 547; Hungary 437; Belgium-Luxembourg 195.
Gold, waste and sweepings thousand troy ounces	64	--	
Iron and steel:			
Ore and concentrate	213,920	60	All to West Germany.
Roasted pyrite	79,745	338,423	Switzerland 94,570; Belgium-Luxembourg 81,155; West Germany 62,048.
Metal:			
Scrap	28,972	48,954	Spain 34,070; Italy 8,262.
Sponge iron, powder, shot	([1])	960	Spain 560; Yugoslavia 400.
Ferroalloys	297	--	
Semimanufactures	59	([1])	Mainly to West Germany.
Lead ore and concentrate	74,762	71,239	Tunisia 18,705; France 15,104; Netherlands 9,662.
Manganese ore and concentrate	110,960	104,438	France 22,954; Netherlands 17,860; West Germany 14,256.
Silver metal, including alloys value, thousands	$2,782	$51	Switzerland $35; United Kingdom $15.

See footnotes at end of table.

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Table 2.—Morocco: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Zinc:			
Ore and concentrate	26,499	19,091	West Germany 7,533; France 6,577; Italy 3,334.
Oxide	4,132	--	
Metal including alloys, all forms	24	--	
Other:			
Ore and concentrate	1,290	1,680	All to France.
Ash and residue containing nonferrous metals	511	6,082	France 5,969.
Oxides, hydroxides and peroxides of metal, n.e.s	10	9	France 6; Libya 3.
NONMETALS			
Barite and witherite	r125,005	119,556	United States 77,516; United Kingdom 8,970; France 7,985.
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite	1,000	1	All to France.
Fire clay	3,761	6,463	NA.
Fuller's earth	23,216	12,815	Spain 9,224; Tunisia 2,465.
Products:			
Refractory (including non-clay bricks)	r6,167	3,717	Lebanon 1,673; Tunisia 1,306; Portugal 371.
Nonrefractory value	r$31,642	$24,361	Saudi Arabia $13,577; Ivory Coast $2,125.
Fluorspar	29,295	27,548	Canada 10,000; West Germany 9,398; Italy 5,500.
Fertilizer materials:			
Crude, phosphatic thousand tons	13,110	14,684	Poland 1,743; Spain 1,391; United Kingdom 1,273.
Manufactured:			
Nitrogenous	262	--	
Phosphatic	87,045	156,410	Burma 29,540; West Germany 27,105; Brazil 20,993.
Gypsum and plasters	197,956	149,312	Nigeria 62,371; Portugal 23,405; Zaire 15,280.
Pigments mineral including processed iron oxides	NA	(1)	NA.
Precious and semiprecious stone, natural and manufactured value, thousands	r$131	$159	West Germany $88; France $53; Spain $18.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	4,096	2,682	Italy 2,297; West Germany 331.
Worked	r34	2	West Germany 1.
Gravel and crushed rock	19,980	15,212	NA.
Sand excluding metal bearing	16,746	2,988	NA.
Sulfur, elemental, all forms	955	--	
MINERAL FUELS AND RELATED MATERIALS			
Coal, all grades, including briquets	r19,402	30,030	United Kingdom 13,145; Tunisia 6,722; Netherlands 5,574.
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	r434	154	Netherlands 141.
Kerosine do	r2	16	NA.
Distillate fuel oil do	r206	596	NA.
Residual fuel oil do	113	104	NA.
Mineral tar and other coal, petroleum or gas derived crude chemicals	(1)	(1)	NA.

rRevised. NA Not available.
[1]Less than 1/2 unit.

Table 3.—Morocco: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum:		
Oxide and hydroxide	1,114	1,415
Metal including alloys, all forms	[1]5,939	6,554
Antimony metal including alloys, all forms	5	12
Arsenic trioxide, pentoxide, acids	2	(1)
Bismuth metal including alloys, all forms kilograms	194	69
Cadmium metal including alloys, all forms do	638	1,013

See footnotes at end of table.

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Table 3.—Morocco: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS —Continued			
Chromium:			
Oxide and hydroxide		1	5
Metal including alloys, all forms	kilograms	251	2
Cobalt:			
Oxide and hydroxide	kilograms	r445	496
Metal including alloys, all forms	do	22	104
Copper:			
Copper sulfate		11	1
Metal, including alloys, all forms		r6,579	6,210
Gold metal, unworked or partly worked	value, thousands	$1,263	$2,361
Iron and steel:			
Metal:			
Scrap		(1)	218
Pig iron, including cast iron		2,250	3,650
Sponge iron, powder, shot		170	257
Ferroalloys		r349	492
Steel, primary forms		17,238	25,958
Semimanufactures:			
Bars, rods, angles, shapes, sections		252,311	325,377
Universals, plates, sheets		r78,448	103,384
Hoop and strip		r10,323	14,018
Rails and accessories		6,431	34,821
Wire		11,293	7,187
Tubes, pipes, fittings		23,384	29,956
Castings and forgings rough		r1,397	8
Lead:			
Ore and concentrate		3	--
Oxides		224	286
Metal including alloys:			
Scrap		--	(1)
Unwrought		2,288	309
Semimanufactures		86	115
Lithium:			
Oxides		30	6
Elemental	kilograms	--	17
Magnesium metal including alloys, all forms	do	5	1,850
Manganese:			
Ore and concentrate		360	213
Oxides		107	136
Mercury:			
Oxides	kilograms	90	47
Metal	76-pound flasks	48	17
Molybdenum:			
Oxides	kilograms	6	8
Metal	do	20	93
Nickel:			
Matte, speiss, similar materials		--	1
Metal including alloys:			
Unwrought		7	14
Semimanufactures		831	640
Platinum-group metals including alloys	value	--	$61
Rare-earth metals:			
Compounds, not further described	kilograms	228	408
Metals including alloys	do	1	348
Selenium, elemental	do	587	202
Silver metal including alloys	value, thousands	$100	$22
Tin:			
Oxides	kilograms	230	20
Metal including alloys, all forms		243	199
Titanium:			
Oxides		778	1,222
Metal including alloys, all forms	kilograms	83	2,332
Tungsten metal including alloys, all forms	do	36	343
Vanadium oxides	do	1	593
Zinc:			
Oxide		437	533
Metal including alloys:			
Scrap	kilograms	111	9
Blue powder		52	51
Unwrought		1,148	2,055
Semimanufactures		r168	98
Other:			
Ores and concentrates, n.e.s		--	(1)
Oxides, hydroxides, and peroxides of metals, n.e.s	kilograms	213	1,516
Thorium and uranium compounds, not further described	do	23	2
Metals including alloys, all forms:			
Gallium, indium, and thallium	do	(1)	90

See footnotes at end of table.

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Table 3.—Morocco: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS —Continued			
Other —Continued			
Metals including alloys, all forms —Continued			
Metalloids, n.e.s	kilograms	45	285
Pyrophoric alloys	do	691	645
Tellurium and arsenic	do	1,050	4,055
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc		44	39
Grinding and polishing wheels and stones		391	373
Asbestos		7,160	6,221
Barite		10	--
Boron materials:			
Crude natural borates		705	841
Oxide and acid		5	5
Bromine	kilograms	277	175
Cement		224,419	689,053
Chalk		4,075	4,994
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite		40	2
Fire clay		11,202	12,263
Fuller's earth		(1)	--
Kaolin (china clay)		1,869	4,583
Other		145	527
Products:			
Refractory (including nonclay bricks)		3,524	4,350
Nonrefractory		4,294	7,425
Cryolite and chiolite		100	(1)
Diamond:			
Gem, not set or strung	value	r$1,528	$1,086
Industrial	do	$14	--
Diatomite and other infusorial earth		197	426
Feldspar		27	25
Fertilizer materials, crude and manufactured:			
Nitrogenous		155,009	192,964
Phosphatic	kilograms	90	10
Potassic		71,453	59,241
Other, including mixed		2,453	20,742
Graphite, natural		11	11
Iodine	kilograms	492	150,648
Lime		10,774	10,432
Magnesite		132	291
Mica:			
Crude, including splittings and waste		3	25
Worked, including agglomerated splittings		2	3
Pigments, mineral, n.e.s.:			
Natural, crude		246	504
Iron oxides, processed		535	630
Precious and semiprecious stones:			
Natural	value	$5,679	--
Sythetic	value	$5,599	$6,962
Salt		11	4
Sodium and potassium compounds, n.e.s.:			
Sodium hydroxide		10,520	13,070
Potassium hydroxide		142	192
Peroxides of potassium and sodium	kilograms	119	232
Stone, sand and gravel:			
Dimension stone		2,356	827
Dolomite, chiefly refractory grade		1,345	960
Gravel and crushed rock		21	436
Sand, excluding metal bearing		22,912	19,812
Sulfur:			
Elemental, all forms		r54,589	183,432
Sulfur dioxide		51	(1)
Sulfuric acid		101,870	71,869
Other nonmetals, n.e.s.:			
Crude, unspecified		315	179
Oxides and hydroxides of magnesium, strontium, and barium		31	12
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		3	11
Carbon black and gas carbon		3,361	187
Coal and coke, including briquets		34,018	38,411
Hydrogen, helium, rare gases		17	20
Peat, including peat briquets and litter		434	386

See footnotes at end of table.

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Table 3.—Morocco: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum:			
Crude	thousand 42-gallon barrels	r19,423	20,753
Refinery products:			
Gasoline	do	53	107
Kerosine	do	87	16
Distillate fuel oil	do	1,393	1,443
Residual fuel oil	do	286	194
Lubricants	do	309	253
Other:			
Liquefied petroleum gas	do	1,032	1,250
White spirit	do	33	30
Mineral jelly and wax	do	99	119
Nonlubricating oils, n.e.s	do	3	5
Asphalt and bitumen	do	(1)	(1)
Bituminous mixtures, n.e.s	do	1	4
Unspecified	do	2	7
Mineral tar and other coal, petroleum or gas derived crude chemicals		810	907

rRevised.
1Less than 1/2 unit.

COMMODITY REVIEW

METALS

Antimony.—Morocco accounted for 2% of the total world antimony production from 12 operating mines in 1977. Société des Travaux et de Recherches Minières (SOTRATEM) operated the Timerdoudine mine, the largest of six mines in the Meknes Province south of Masseramane. The Timerdoudine was an underground mine producing from stibnite veins with quartz gangue in Paleozoic schists associated with microdiorite. SOTRATEM produced over 3,000 tons antimony concentrate from five mines in 1977. Beni Mezala mined antimony in the Tetouan district and produced around 350 tons of antimony concentrate (46% antimony) in 1977. A bilateral cooperation agreement was signed between Morocco and France that would allow the French Bureau de Recherches Géologiques et Minières (BRGM) to reevaluate the antimony potential of the central Hercynian Mountains of Morocco.[8]

Copper.—The principal operators of seven producing copper mines in the country comprised the following: (1) Société Minière Marocaine (SOMIMA), 74.88% owned by BRPM and the largest copper producer for 1977 with 6,950 tons of copper concentrate recovered. SOMIMA exploits mines at Talat N'Ouamane in Agadir district and at Ouansimi in the Tisnit Province. N'Ouamane was to produce 7,800 tons per year and was under development. (2) Soc. des Mines de Bou Skour (SMBS), owned 41% by BRPM, 33% by Omnium Nord-African (ONA), and 8% by BRGM of France. SMBS operates the Bou Skour mine, which was the second largest copper producer with 4,194 tons of copper concentrate in 1977. (3) Société de Developpement du Cuivre de l'Anti Atlas (SODECAT), 100% owned by BRPM, produced 3,957 tons of 34% copper concentrate from the Tazalaght and Assif Imider mines located in Agadir Province. An average of 250 grams silver was also recovered for each ton of concentrate.

Several copper mines, including Bleida, Assif-Imider, and Oumejrane mines, were under development beginning in 1976. Bleida mine, being developed by Société Minière de Bou Saffer, was owned 40% by BRPM, 40% by ONA, and 20% by MTS. The Bleida mine was planned to produce 15,000 tons copper metal by 1980. Reserves were estimated at 2.5 million tons of 6% copper. The washing plant was to handle 800 tons per day. An investment of $3.4 million was required. Assif-Imider mine, under development by SODECAT, started production in 1977 and was to eventually produce 2,500 tons per year of 50% copper concentrate and 1 gram per ton silver. An investment of $2.2 million was required. Oumejrane mine, 55% owned by BRPM, was expected to be producing 1,800 tons per year of cement copper (80% copper) by yearend 1977. Located in Zagora region near Ouarzazate, the reserves were estimated at 180,000 tons of 1.8% copper. B. Kersia mine, which was to have its development integrated with Ou-

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mejrane, had a potential of 592,000 tons of 2.36% copper. The copper mine at Naour, owned 50% by BRPM, was under study.

A new copper smelter was to be located at Agadir and owned by Fonderie Marocaine de Cuivre (SOFOMAC), which was owned 65% by BRPM and 35% by Zellidja S.A. Arab Mining Co. was also to participate in financing the 30,000-ton-per-year copper smelter. Technical and economic feasibility studies were underway. Sulfuric acid will also be produced.

Iron Ore.—The Société d'Exploitation des Mines de Fer du Rif (SEFERIF), owned 100% by BRPM, was mining iron ore from four mines. The mines were located at Nador, where the Uixan No. 1 (two pits, one at Uixam and one at Axora, which was also underground), the Uixan No. 2 (F) and No. 2 (G) and Pellets mines were producing over 400,000 tons per year, mainly for export. The pit at Axora was estimated to have 24 million tons of 50% iron and 4% silica. The ore was magnetite with some pyrite, which was eliminated by roasting. Approximately 1,400 workers were employed at the iron mines. Steel plant operation by Société Nationale de Siderurgie (SONASID) was scheduled for 1981. The opening of the Nador iron and steel complex, anticipated by the new 5-year plan with capacity approaching 1 million tons of steel per year, was expected to be an important outlet for local iron ore production.

Lead and Zinc.—Morocco accounted for 3% of total world lead production in 1977. The numbers of operating lead and zinc mines included 36 lead and 14 zinc producers. Zellidja Société Anonyme, owned 19.5% by SNI, 31.3% by OCP, 6.6% by Penarroya-Maroc, 3.8% by Academie Francaise, 9% by Newmont Mining Corp., 5% by BNDE, 3.8% by AMI, and 21% by others, operated the Bou Beker mine, located south of Oujda. Compagnie Minière de Toussit (CMT), owned 50% by Compagnie Royale Asturienne des Mines (CRAM), 20% by SNI, 15% by Matran (Société Morocaine), 1% by Metal Afrique (Société Morocaine), 5% by Société Safari, 5% by Fonds Marocain de Placement, and 4% by Société Amrina, exploited the Beddiane and Oued Mekta mines of Oujda Province. Société Developpement Industrielle et Minière de la Haute Moulouya (SODIM), owned 50% by BRPM and 50% by Zellidja S.A, operated the Zeida mine in the Khenifra Province. Central d'Achat et Developpement de la Règion Minière du Tafilalet et de Figuig (CADETAF) is a miners' cooperative that operated several mines in Errachidia and Figuig Provinces. Société des Travaux et de Recherches Minières (SOTRATEM), owned 42.8% by Société Parminaf, 20% by Heritiers Barandi, 20% by Lazrek, 10% by Moukacha, 2.8 by% Guerar, 2.9% by Pascal, and 1.5% by Olivera, operated mines at Seksaoua, Timerdoudine, Touriti, and the Figuig district. Société des Mines Dj. Aouam (SMA), owned 33.33% by BRPM, 33.33% by CRAM, and 33.33% by Vieille, operated the Djebel Aouam mine in Meknes Province. Société Aouli, owned 64% by the BRPM, operated mines at Aouli and Mibladen.

The Bou Beker deposit, mined by Zellidja, was a Mississippi Valley type, occurring in veins and disseminations in limestones and dolomites. The underground mine produced about 11,000 tons per year of 60% zinc concentrate, but the mine was considered to have a limited life. Bou Beker ore occurred on both sides of the Algerian-Moroccan border, with most of the ore reserves on the Algerian side. A new addition was made to the treatment plant in 1976 to treat rejects, as well as a new tailings flotation plant. The crushing and milling plants have a 4,000-ton-per-day capacity.

Reserves were estimated at CMT's Oued Mekta mine to be 1.5 million tons of 12% lead. The underground mine was producing about 4,500 tons per month of 70% lead concentrate. Mining equipment was upgraded in 1976 to raise the capacity to 30,000 tons per year of concentrates. A gravimetric plant being installed as the treatment plant at Touissit was insufficient. Reserves at the Beddiane mine were estimated at 5 million tons of 16% lead. Production was at the rate of 1,500 tons per month in the underground mine at Beddiane.

The open pit mine at SODIM's Zeida mine was producing both lead and barite from reserves that were estimated at 11 million tons of 4% lead ore. Zeida was considered to be the mine most likely to carry out large-scale lead mining once Bou Beker was closed. In 1977, 54,748 tons of lead concentrate was produced at the Zeida mine.

Lead-zinc deposits in the Tafilalet area consisted of about 70 subvertical veins (about 40 have been worked) that were mineralized with galena, some sphalerite, and vanadinite with barite or siderite gangue. In Errachidia Province, there were 10 lead mines, all operated by small producers except the Tafilalet mine exploited by CADETAF. Most veins are less than 5 meters

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wide. The regional formations are Upper Devonian schists with many volcanic injections. CADETAF was considering a joint construction project with Zellidja for a calamine and zinc oxide plant. There were six operating mines in the Figuig district, and the largest, the Tameslemt mine, was operated by SOTRATEM.

The SMA Djebel Aouam mine, in Meknes Province, was estimated to have ore reserves of 1.5 million tons containing 7.43% lead, 1.97% zinc, and 155 grams per ton silver. The Aouli mines produced 2,200 tons of lead concentrate in 1977.

The lead foundry, located at Oued El Heimer, built by Zellidja and Penarroya, and owned 26% by BRPM, was officially opened in June 1975. The smelter capacity was to be increased to 48,000-ton capacity by 1980. In 1977, it produced 33,436 tons of lead metal and 9,600 kilograms of silver. The smelter was to be supplied exclusively from ores of the CMT Beddiane and Oued Mekta mines. A new, 80,000-ton-per-year lead smelter was to be built near Meknes by Fonderies Chérifienne de Plomb (FCP), that will process the concentrates from the Zeida and Jebel Aouam mines. FCP was to be owned 75% by BRPM and 25% by the Arab Mining Company, which is based in Amman, Jordan.

Manganese.—Of the four producing manganese mines, the Imini mine was by far the largest, contributing over 90% of the total 113,547 tons of chemical-grade manganese produced in 1977. The undergound Imini mine was operated by the Société Anonyme Chérifienne d'Études Minières (SACEM), which was owned by BRPM (47.14%), Compagnie de Mokta (47.14%), IMETAL (3.19%), and ONA (2.5%). The manganese was hauled by truck to Marrakech and by train to Casablanca. The fourth washing plant was recently upgraded for greater recovery of ultrafines. The manganese deposits of the Anti-Atlas area, taking Ouarzazate as center, fill a large number of fractures in Paleozoic rocks. Braunite is dominant and the gangue is silica, barite, or more rarely, calcite. The Imini mine life was considered limited.

Pyrite and Pyrrhotite.—The Kettara mine was being exploited for pyrite and pyrrhotite by the Société du Exploitation Pyrrhotine de Kettara (SEPYK), owned by BRPM (47.4%), OCP (12%), Finances (39.2%), and CMM (1.4%). The sulfur produced was used by chemical and fertilizer plants at Safi, 120 kilometers away. The new Maroc Phosphore II complex was expected to consume 1,250,000 tons of sulfur and 320,000 tons of pyrrhotite. A concentrator, started in July 1972, raises the sulfur content from 25% to 33%. The ore body has a cap of hematite-limonite with pockets of ocher that is also recovered. The roasted pyrite was exported to European processers.

Uranium.—Negotiations were being carried out with several firms including three U.S. companies — Gulf Oil Corp., Westinghouse Electric Corp., and the Uranium Recovery Corp. — for extracting uranium from phosphate rock. A new Atomic Energy Commission was to oversee development of the uranium extraction plants. Uranium reserves in phosphate were estimated at 18 million tons.[9] Two extraction units were being contemplated and would be associated with two of the three acid plants in operation at Safi, Maroc-Chimie 1 and 2, and Maroc Phosphore 1. Extraction of uranium is estimated to yield about 1 pound of uranium oxide per ton of phosphoric acid produced. With the uranium produced, Morocco was planning to establish its first nuclear powerplant, probably of 1,300-megawatt capacity. This plant would consume about one-third of the potential uranium production. The remainder would be exported.[10] The BRPM announced the discovery of interesting uranium occurrences by drilling in Upper Moulouya, east of Zeida (Middle Atlas Mountains) and in the Marrakech area at Wafaga (High Atlas).

NONMETALS

Barite.—Barite production was 149,920 tons in 1977; this compares with 129,215 tons produced in 1976. This production originated from 44 operating mines, among which the principal producer was Compagnie Marocaine des Barytes (COMABAR), owned 50% by BRPM. COMABAR produced 56,703 tons from the Jebel Irhoud mine of Safi Province. The Jebel Takoucht and Targa mines, owned by SMIDEL, have production capacity of 35,000 tons yearly and were the two largest barite mines of the 19 operating in Marrakech Province. The Mining and Minerals Division of Chromalloy joined SMIDEL in its barite operation near Imigdal. Total combined capacity of SMIDEL's grinding plants, located at Marrakech and Casablanca, was 45,400 tons per year. The Tessaout deposits of Somatrex (a subsidiary of Marogypse) produced about 35,000 tons per year of crude barite. Ste. de Recherches Minières NADIA mines barite

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at Asni, Imlil. Barite concentrate was also recovered by Zellidja S.A. from its lead-barite ore at Zeida near Midelt at the rate of about 10,000 tons barite per year.

Cement.—The construction boom was showing no signs of slowdown, and cement demand was high. Local consumption of cement was expected to exceed 10 million tons per year by 1985. Moroccan cement production increased 23% in 1977 to a total of 2.9 million tons, or an average of 239,000 tons per month.[11] Loans for two new cement plants, one at Oujda and one at Temara, were secured. The Arab Fund for Economic and Social Development was to loan $27 million out of the total $67 million required for construction of the Cimenterie de l'Oriental cement plant at Oujda. Expected to be operating by 1978, the Oriental plant was to have an initial capacity of 600,000 tons per year and a total of 1,200,000 tons per year by yearend 1979. The Asment de Temara S.A. plant, under construction near Rabat, was to cost around $61.7 million and was to be funded by an international assortment of credit institutions. Financing was to come from the International Finance Corp. (IFC) of the World Bank, the Arab Investment Co. of Saudi Arabia, the Islamic Development Bank, the Chemical Bank of New York, the Eximport Bank, and BNDE of Morocco. Expected to be operating by 1978, the Temara plant was to have an initial 300,000-ton-per-year capacity increasing to 690,000 tons per year by 1979.

Additional cement capacity was being constructed at the operating plants of (1) Ste. des Ciments de Marrakech S.A. at Marrakech (208,000 tons per year to 500,000 tons per year); (2) Cementos Marroquies C.M.A. at Tetuan (180,000 tons per year to 250,000 tons per year); (3) Cementos Tanger S.A. at Tanger (100,000 tons per year to 250,000 tons per year); and (4) Ste. des Ciments Artificiels de Meknes, at Meknes, (635,000 tons per year to 720,000 tons per year). A total of nine cement plants were to be operating by yearend 1978 with an estimated total yearly capacity of 3.9 million tons increasing to 4.8 million by yearend 1979.

Fluorite.—The Société Anonyme d'Enterprises Minières (SAMINE), owned by BRPM (40%), ONA (26%), Ugine Kuhlmann (20%), and and Preussag (14%), operated the fluorite mine at El Hammam. Located in the Moyen Atlas Mountains in Khemisset Province, the El Hammam mine was reactivated in 1969 but has operated for the past several years at about two-thirds of its capacity (60,000 tons) because of depressed world markets. An increase in exports during 1977 allowed some drawdown in stocks, and development plans were anticipating an increase in production to 80,000 tons by 1980. A new shaft was expected to be in operation by 1979. The New Rouif vein was being prepared for mining and assayed 34.8% fluorite, 14.1% barite, 1.9% lead, and 60 grams per ton silver.

Phosphate Rock.—Moroccan Government estimates of ore reserves were being given as 58 billion tons exploitable with current mining technology and a possible production range of 80 to 200 million tons per year for the future. Development plans were envisaged that included phosphate rock production of 40 million tons per year by 1987 and 70 million tons per year by 1990. In addition to increased mine and port handling capacities, additional development of processing facilities were also planned. In 1977, only about 10% of Moroccan phosphate rock was being processed in the country; this was to be expanded to 30% by 1985. The Government was to spend over $2 million for new chemical-processing capacity over the 1978-85 period, in order to accomplish the 30% domestic conversion target.

Phosphate rock production continued below capacity in 1977, but was up 12% compared with that of 1976, and down 12% from the record high production of 19.7 million tons in 1974. The two established mines at Khouribga and Youssoufia in central Morocco had a combined production capacity of 21 million tons per year. Fosfatos de Bu Craa in the Western Sahara had a capacity of 5 million tons per year. There were two mines being developed at Benguerir, expected to come onstream in the early 1980's and to reach 9.75 million tons per year by 1990. A third new mine was being built at Sidi Hajjaj, scheduled to come onstream by 1987 with 3 million to 5 million tons per year production capacity, eventually producing 10 million tons per year. A new mining site at Youssoufia was to contribute about 1 million tons per year. A new mine at Meskala was under negotiations with the U.S.S.R. and would produce 10 million tons per year. Guerrilla actions in the western Sahara was preventing a long-term development program.

At yearend, terms for a long-term barter agreement involving development of the Meskala deposits were being finalized with

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the U.S.S.R. The arrangements were to cover a 30-year period, would initially involve a Soviet investment of some $2 billion, and would eventually result in an annual export of some 10 billion tons of phosphate rock, triple-super-phosphate, and phosphoric acid to the U.S.S.R. The Soviets were to develop and equip the mine, which was reported to have reserves of 9 billion tons with 72% bone phosphate of lime. A new harbor at Essouira and a 60-kilometer railroad were also to be constructed. The project would take 8 to 10 years to complete. When the Soviet investment is paid, the phosphates will continue to be exported in exchange for Soviet oil, timber, chemical products, and mining equipment. Phosphate prices would be renegotiated every year, and a safeguard clause would prevent resale by the Soviets. Phosphate rock prices dropped from $68 per ton in 1975 to nearly $30 per ton in 1977. The agreement would also help Morocco adjust the trade deficit with the U.S.S.R. that had widened since oil prices rose dramatically in 1974. In 1976, petroleum accounted for about 85% of the value of Soviet exports to Morocco.[12]

A $230 million contract was awarded to Heurtey Industries of France to build the Maroc Phosphore II plant near Safi, scheduled for completion in 1981. The complex will consist of three sulfuric acid units with total capacity of 1.9 million tons per year, and three phosphoric acid units with total capacity of 550,000 tons per year. All of the sulfuric acid units were to use Monsanto Enviro-Chem Inc.'s single-absorption design, mist eliminators, and vanadium catalysts. The Uhde France Company would supply the three phosphoric acid plants, which would use the Nissan process. The plant would process 1.7 million tons per year of crude phosphates and 530,000 tons of sulfur per year. A group of banks led by Frab Bank International were to provide the loan for the plant construction.

The Saudi Development Fund (SDF) loaned the Moroccan Government $100 million, of which $33.9 million was to be used in establishing the new phosphate export port at Jorf Lasfar, south of Casablanca. The port would handle exports from the Beguerir and Sidi Hajjaj expansions.

OCP became the principal shareholder in the French chemical- and gas-shipping group, Gazocean S.A., by increasing its stockholding to 25%. The Moroccans also had the option of increasing their shares to 42% by July 1, 1980. The Moroccan company, Marphocean (owned 35% by CP and 25% by Gazocean), was to take over financing and operations of the two specialized phosphoric acid carriers that were originally ordered by Gazocean. One carrier was ready for service and the other was to be delivered by yearend 1977. Marphocean would then become the largest phosphoric acid shipper in the world with a six-ship fleet and total shipping capacity of 100,000 tons.[13]

Western Sahara.—Destruction of power pylons linking the Bu Craa mine with a power station 107 kilometers away and several sections of the conveyor belt effectively kept the mine unproductive for most of the year. Through much of 1977, Fosfatos de Bu Craa (Fosbucraa), owned 65% by OCP and 35% by Spain's Instituto Nacional de Industria (INI), was using trucks to transport the rock to port El Aaiun, 100 kilometers away. The company was hauling 2,000 tons per day from a stockpile at the mine site to the port in heavily guarded convoys. Only 450 of the original 1,500 Spanish mine workers were reported to have remained on the job after OCP took over controlling share and guerrilla warfare began.[14] In the closing months of 1977, OCP began to operate the Fosbucraa beneficiation plant at El Aaiún, producing some 230,000 tons of concentrate.

MINERAL FUELS

Bituminous Shale.—Research on bituminous shale at Timhadit and Tarfaya was being conducted by BRPM and the Oil Shale Corp. of the United States. Existence of several billion metric tons of oil shale was verified with drilling, and studies to determine the oil content were being conducted. A delegation of Spanish experts was also interested in the potential of these deposits and had visited Morocco to discuss them.

Coal.—Situated in northern Morocco, the Jerada anthracite deposit covered a surface of about 100 square kilometers and was estimated to have reserves of 100 million tons. Discovered in 1927, exploitation did not start until several years later by Société Cherifienne des Charbonnages de Djerada (SCCD), which in 1977 was owned 98.89% by BRPM. In 1977, two pits were being exploited, and a new pit under development was expected to attain a capacity of 1 million tons by 1980. The coal was used locally for fuel in cement plants, sugar refineries and other small industries, and for generation of electricity. Only limited quantities were

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available for export. Approximately 5,000 workers were employed at the coal mines.

Petroleum.—Morocco awarded offshore drilling permits to several oil consortiums off the coast of the Western Sahara, between El Aaiún and Boujdour, and off Essaouira for 4,000 square kilometers on the Sminou permit. Fourteen exploration permits were granted for the Western Sahara during 1977 and early 1978. A consortium made up of BRPM, Phillips Petroleum, and British Petroleum Co., Ltd. (BP) head 10 of the offshore Sahara exploration permits. Getty Oil and Agip S.p.A. were to join Phillips and BP in prospecting off Essaouira. BRPM had already discovered small oil and gas deposits on the mainland near Essaouira. The petroleum reserves at Essaouira were estimated to be about 1 billion cubic meters, and an announcement of a new deposit at Toukimt was also confirmed. Sun Oil found petroleum shows near Ifni, and a second exploration effort was to be made near Agadir at yearend 1977.[15] The Government was also encouraging petroleum exploration in the deep sedimentary basins of the Rif region where it was hoped that new geophysical techniques would enhance the prospects of locating petroleum and gas deposits. Natural gas reserves were estimated to be about 1 billion cubic meters, which at the present rate of production would last 11 years.[16]

Most domestic refined needs were produced by the Government-owned refinery at Société Anonyme Marocaine de l'Industrie du Raffinage (SAMIR), located at Mohammedia. An extension was being financed by the Saudi Arabian Monetary Agency, which would increase the refinery capacity from 2,250,000 tons per year to 5,750,000 tons per year. An agreement was signed on March 10, 1977, for a loan of $28.3 million.[17] Refinery input for 1977 was 2.9 million tons of crude oil, most of which was imported. The Société Nationale des Produits Petroliers (SNPP) reported oil product sales had increased 8.7% over 1976. The country was 80% self-sufficient in refined products; the remaining 20% was imported. New lubricant and bitumen plants were to be built at Mohammedia under the next development plan, while a project for a third refinery with 4 million tons per year capacity was under study for Jorf Lasfar.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Moroccan dirhams (DH) to U.S. dollars at the rate of DH4.50=US$1.00.

[3]U.S. Embassy, Rabat, Morocco. State Department Airgram A-19, Apr. 21, 1978, 19 pp.

[4]U.S. Consulate, Casablanca, Morocco. State Department Airgram A-8, May 13, 1977, 8 pp.

[5]Mining Journal (London). Production, More North African Phosphate. V. 290, No. 7441, p. 234.

[6]Phosphorus & Potassium (London). Phosphate Rock, Production Hits New Peak in 1977. No. 93, January/February 1978, p. 10.

[7]U.S. Bureau of Mines. Cobalt. Ch. in Mineral Commodity Summaries 1979. January 1979, p. 39.

[8]Industries et Travaux d'Outre-mer (Morocco). BRGM In the World. No. 298, September 1978, p. 662.

[9]Phosphorus & Potassium (London). World Trends, Phosphate Rock. No. 87, January/February 1977, p. 15.

[10]European Chemical News. ECN Technology. V. 31, No. 810, p. 29.

[11]U.N. Monthly Bulletin of Statistics, 36. Cement. V. 32, No. 6, June 1978, p. 74.

[12]Industrial Minerals (London). Morocco, U.S.S.R.... "Super" Phosphate Deal. No. 126, March 1978, p. 13.

[13]European Chemical News. Morocco: OCP Steps in to Rescue Gazocean Shipping Group. V. 32, No. 795, July 15, 1977, p. 6.

[14]Chemical Week. International Newsletter. Mar. 2, 1977, p. 25.

[15]Industries et Travaux d'Outre-mer (Paris). Mining Activities. No. 286, September 1977, p. 627.

[16]Petroleum Economist (London). World: Estimated Commercial Production of Natural Gas and Proved Reserves. V. 45, No. 9, September 1978, p. 362.

[17]Industries et Travaux d'Outre-mer (Paris). Morocco. V. 25, No. 281, April 1977, p. 243.

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The Mineral Industry of Mozambique

By David E. Morse[1]

The mineral industry of Mozambique, as well as most sectors of the nation's economy, struggled through a difficult year in 1977. Important factors contributing to the country's economic contraction were the exodus in 1975 and 1976 of trained managers and technically skilled personnel, disruptions resulting from the restructuring of the society to meet the postindependence framework of national goals, continued low worker productivity, and the loss of foreign exchange earnings that had been derived from the transport of Southern Rhodesian imports and exports prior to the closure of the border in March 1976. Foreign exchange earnings also declined because of the fall in the number of Mozambicans working in the Republic of South Africa. At the end of 1977, there were 34,000 Mozambicans working in the Republic of South Africa, compared with an average of 100,000 in 1975 and approximately 65,000 in 1976.

Despite stringent import restrictions, the 1977 balance-of-trade deficit escalated to $345 million owing to export stagnation and a 25% increase in imports. Coal, cement, refined petroleum products, and tantalite-microlite concentrates were Mozambique's most important mineral exports. Prime contributors to the large trade deficit in 1977 were the depressed level of the nation's agricultural exports and the larger volume of imported crude petroleum, foodstuffs, steel, and textiles.

The Cabora-Basa Gorge hydroelectric project, which spans the Zambezi River in the central Tete District near Songo, began commercial production of electric power in March. All of the electricity generated was exported to the Republic of South Africa over a 1,400-kilometer-long, dual 530-kilovolt transmission line. During 1977, Zambeze Consorcio Hidro-Electrico Lta. (Zamco) continued to erect two 405-megawatt generators in the southern power station to complement the three operating generators of equal rating. The 163-meter-high dam and all other major structures had been completed, and Zamco planned to finish work on the remaining generators and powerhouse equipment in 1979. Although the project provides jobs for local workers, tax income for the Government, and a means for regulating floods, Mozambique will receive the revenue from electricity generated at Cabora-Basa only after the creditors have been paid, which is to be in 1992. The dam was designed so that four additional 405-megawatt generators could be installed in a power station in the north, giving the project an ultimate capacity of 3,600 megawatts.

During 1977, the Government took action to attract and reassure foreign investors. Decree Law 18-77, promulgated in April, outlined the terms of foreign participation and guaranteed investors the rights of profit repatriation and protection from nationalization.

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Table 1.—Mozambique: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Aluminum: Bauxite, gross weight	2,175	[e]2,000	--
Beryllium: Beryl concentrate, gross weight	9	([2])	NA
Bismuth, mine output, metal content kilograms	1,000	--	--
Columbium and tantalum ore and concentrate, gross weight:			
Columbite[e] do	2,800	1,700	2,300
Microlite do	44,000	55,921	39,866
Tantalite[e] do	[r]43,200	[r]28,000	36,300
Copper, mine output, salable ore and concentrate:			
Gross weight	3,212	--	--
Metal content	803	--	--
Gold, mine output, metal content[e] troy ounces	20	([3])	--
NONMETALS			
Cement, hydraulic thousand tons	281	217	323
Clays:			
Bentonite (including montmorillonite)	5,802	2,298	2,744
Kaolin (including china clay):			
Crude	454	[e]450	--
Washed	[e]200	[e]200	--
Feldspar[e]	850	850	900
Fertilizer materials, manufactured:			
Ammonium sulfate (21% N)	4,451	17,500	22,250
Superphosphates (18% P_2O_5)	6,601	4,100	7,150
Granulated nitrogen-phosphorus-potassium compounds	12,600	9,700	11,500
Gem and ornamental stones:			
Beryl crystals kilograms	13	32	14
Garnet do	NA	2,360	1,871
Tourmaline do	NA	25	26
Lime, hydraulic	535,867	[r e]100,000	[e]100,000
Lithium minerals:[e]			
Lepidolite	730	730	--
Spodumene	25	25	--
Mica, mainly scrap[e]	900	900	800
Salt:			
Marine	31,301	28,000	28,000
Rock[e]	20	20	20
Stone and sand:			
Limestone thousand tons	[e]600	NA	NA
Granite and other quarry stone do	107	NA	NA
Sand do	[r e]700	NA	NA
Sulfuric acid	8,548	15,300	18,750
MINERAL FUELS AND RELATED MATERIALS			
Coal, bituminous thousand tons	575	553	310
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	536	473	621
Kerosine do	241	195	178
Jet fuel do	61	56	128
Distillate fuel oil do	704	613	865
Residual fuel oil do	1,113	1,003	1,438
Other do	179	167	63
Refinery fuel and losses do	312	278	299
Total do	3,146	2,785	3,592

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, other crude construction materials and additional varieties of gem and ornamental stones presumably are produced, chiefly for local consumption, but available information is inadequate to make reliable estimates of output levels.

[2]Less than 1/2 unit.

[3]Revised to none.

COMMODITY REVIEW

METALS

Bauxite.—No bauxite production was reported by the Mozambique Department of Geology and Mines for 1977. The Alumen mine had produced 5,000 to 7,000 tons per year of bauxite grading 62.3% Al_2O_3, 3% SiO_2, and 2.22% Fe_2O_3 until 1974. Production in 1975 was 2,175 tons. Output in 1976, estimated at 2,000 tons, was affected by the closure of the Southern Rhodesian border, as Southern Rhodesia had been the largest consumer of the mine's output. Reserves at the mine at Melange near Manica in the Vila Pery District were reported to be an estimated 60 million tons of bauxite averaging 44% Al_2O_3.

Copper.—The Edmundian copper mine,

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located between Manica and the Southern Rhodesian border in the Vila Pery District, was abandoned by its owners following the closure of the Southern Rhodesian border in 1976 and was subsequently nationalized by the Mozambique Government. The mine did not operate throughout 1977; the Government announced plans to reactivate the operation in early 1978. A production level of 230 tons per month of chalcopyrite concentrate was anticipated when full operation is restored in mid-1978.

Iron Ore.—The Swedish Aid Authority, acting on a request by the Mozambique Government, engaged Luossavaara-Kiirunavaara AB (LKAB) International to carry out primary investigations on the Honde iron ore deposits in west-central Mozambique. The deposits, located along the banks of the Honde River, are composed of a number of itabirite outcrops containing an estimated 100 million tons of ore with an average grade of 38% iron.

NONMETALS

Cement.—Production of cement in Mozambique's three plants increased 49% over that of 1976 but remained well below the 990,000-ton-per-year installed capacity. Mozambique's cement plants were located at Matola near Maputo in the south, at Dondo near Beira in central Mozambique, and at Nacala (a small unit) in the less populous north. All of the plants were coal-fired, and the effect on output by the closure of the Moatize coal mine in August was not known. Approximately 50,000 tons of cement was exported to Tanzania in 1977.

Fertilizer Materials.— Mozambique's Government-managed fertilizer plant, Quimica Geral at Matola, continued to operate below capacity owing to a lack of spare parts and a shortage of trained technicians. The Government planned to bring the plant's sulfuric acid unit to designed output and double ammonium sulfate production in 1978.

MINERAL FUELS

Coal.—Mozambique's only large coal-mining operation, owned by Cia. Carbonifera de Moçambique S.A.R.L. (CCM), sustained a major coal dust and methane gas explosion on August 3 in the company's Chipanga No. 3 mine. The disaster, coupled with a loss of production from Chipanga No. 7 because of excessive water and the September 1976 disaster in Chipanga No. 6, effectively terminated coal-mining operations at CCM's Moatize concession, located 30 kilometers east of Tete in the Tete District. Coal reserves in CCM's 31-square-kilometer concession area were reported at 400 million tons. Two West German companies were conducting a feasibility study in 1977 to determine the viability of a 2-million-ton-per-year opencast operation in a section of the company's concession area.

Petroleum.—No petroleum exploration activity was reported in Mozambique in 1977, and no petroleum concessions were in force during the year. The Government nationalized the nation's only oil refinery at Matola and assumed control of petroleum product marketing and distribution on May 1. Empresa Nacional de Petroleos de Mozambique was established to operate the refinery and market petroleum products. Most of the crude oil processed at the refinery was imported from Iraq. Refinery output increased 29% in 1977 but was only 62% of plant capacity.

[1]Physical scientist, Branch of Foreign Data.

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The Mineral Industry of the Netherlands

By William F. Keyes[1]

Expectations early in the year for continued recovery of the Dutch economy were not realized. Unemployment and inflation again rose, and for the first time since 1970, the balance of payments on current account was in deficit. The estimated real growth of the gross national product was revised downward to 3% per year for 1977 and 1978.

The condition of the economy, which was shared by the mineral extractive and processing industries, was a reflection of the worldwide economic slowdown, but numerous analysts pointed to the influences of the "Dutch disease," a popular term for the effects of the massive production of natural gas on the economy.

During the 4 years before gas revenues began to flow in regularly, the Netherlands averaged an annual trade deficit of about $130 million;[2] since 1972, the balance of trade has averaged a $2 billion annual surplus. The revenues were used to raise wages, social benefits, and the standard of living generally, but were not used proportionately in industrial modernization. A resultant high inflation rate affected industry competitiveness and led to unemployment.

The Netherlands remained a significant producer of natural gas in 1977; there was also appreciable production of petroleum, salt, and cement. Among mineral products derived from imported ores were significant amounts of aluminum, iron and steel, lead, zinc, and petroleum products. Developments in the mineral industry during the year included a decision to cut back on steel expansion plans, the beginning of imports of natural gas (in spite of a domestic surplus), and a continuing increase in offshore gas supplies.

PRODUCTION

The major extractive industries, including natural gas, salt, and petroleum, showed little change in production in 1977, but the indexes of the mineral-processing industries declined: Base metals including steel, from 111 to 107, and petroleum refining, from 111 to 109. Table 1 gives production of mineral products for 1975-77.

Table 1.—Netherlands: Production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity[1]		1975	1976	1977[p]
METALS				
Aluminum metal, primary	tons	260,833	255,504	241,269
Cadmium metal	do	[r]271	397	302
Iron and steel:				
Sintered ore (from imported ore)		2,842	2,582	2,709
Metal:				
Pig iron, including blast-furnace ferroalloys		3,970	4,265	3,922

See footnotes at end of table.

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Table 1.—Netherlands: Production of mineral commodities —Continued

(Thousand metric tons unless otherwise specified)

Commodity[1]		1975	1976	1977[p]
METALS —Continued				
Iron and steel —Continued				
Metal —Continued				
Steel, crude		[r]4,823	5,189	4,927
Semimanufactures		4,051	4,530	4,251
Lead metal, primary	tons	23,940	21,890	21,132
Tin metal:[e]				
Primary	do	1,800	2,000	2,100
Secondary	do	180	180	180
Zinc metal, primary	do	123,942	140,807	109,398
NONMETALS				
Cement		3,706	3,481	3,896
Fertilizer materials, manufactured:				
Nitrogenous, N content		1,214	1,071	1,081
Phosphatic, P_2O_5 content		259	233	281
Salt, all types		2,690	3,026	3,111
Sand, industrial		21,600	24,400	25,600
Sulfur:				
Elemental, byproduct		107	105	[e]80
Sulfuric acid (100% H_2SO_4)[2]		[r]1,292	1,402	1,572
MINERAL FUELS AND RELATED MATERIALS				
Carbon black	tons	79,600	90,000	90,700
Coke		2,680	2,813	2,501
Gas:				
Manufactured, all types[3]	million cubic feet	[r]247,381	259,941	219,395
Natural:				
Gross	do	3,208,428	3,436,171	3,421,940
Marketed	do	[r]3,188,970	3,426,813	[e]3,410,780
Petroleum:				
Crude	thousand 42-gallon barrels	9,672	9,345	9,420
Refinery products:				
Gasoline:				
Aviation	do	1,157	1,228	1,095
Motor	do	54,774	59,118	54,460
Jet fuel	do	21,952	23,888	24,320
Kerosine	do	4,611	5,193	4,487
Distillate fuel oil	do	120,375	134,496	133,974
Residual fuel oil	do	132,088	144,395	131,868
Lubricants	do	2,786	6,601	3,892
Bitumen	do	6,193	6,260	5,660
Liquefied petroleum gas	do	10,428	12,203	11,832
Other	do	44,270	71,409	57,574
Refinery fuel and losses	do	24,355	25,592	18,943
Total	do	422,989	490,383	448,105

[e]Estimate. [p]Preliminary. [r]Revised.

[1]In addition to the commodities listed, the Netherlands presumably produces a variety of crude construction materials (clays, stone, and gravel), but production is not reported and available information is inadequate to make reliable estimates of output levels.

[2]Series revised to represent total national production; data published in previous editions represented marketed production only, not including production by companies for their own use.

[3]Coke oven and blast furnace gas only.

TRADE

The Netherlands continued to be a major importer and consumer of raw and semifinished mineral products, including petroleum, iron and steel, nonferrous metals, and fertilizers. As shown in table 4, the country purchased large amounts of U.S. molybdenum ore, gem diamond, phosphate rock, coal, and certain petroleum products. It shipped to the United States sizable quantities of iron and steel semimanufactures, cut diamond, zinc, and certain other petroleum products.

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Table 2.—Netherlands: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Bauxite	2,652	5,605	West Germany 2,393; Sweden 1,001; Algeria 489.
Oxide and hydroxide	25,816	28,762	West Germany 9,668; France 4,405; United Kingdom 4,277; Italy 3,489.
Metal including alloys:			
Scrap	32,980	48,510	West Germany 32,258; Italy 6,532; Belgium-Luxembourg 4,107.
Unwrought	264,181	290,357	Belgium-Luxembourg 107,698; West Germany 81,196; France 72,644.
Semimanufactures	63,352	84,439	West Germany 34,683; Belgium-Luxembourg 19,051; France 11,778.
Antimony metal including alloys, all forms	60	66	East Germany 28; West Germany 20; Bulgaria 10; India 7.
Arsenic oxides and acids	163	128	France 66; West Germany 48.
Bismuth metal including alloys, all forms	41	50	France 15; Spain 8; West Germany 6; Denmark 5.
Cadmium metal including alloys, all forms	341	474	United Kingdom 137; France 126; Belgium-Luxembourg 82; West Germany 77.
Chromium:			
Chromite	27,289	23,675	West Germany 9,017; France 7,819; United Kingdom 1,767.
Oxide and hydroxide	282	433	West Germany 233; Italy 155.
Cobalt:			
Oxide and hydroxide	10	39	Belgium-Luxembourg 17; West Germany 12; Spain 5.
Metal including alloys, all forms	117	124	Japan 50; France 25; Sweden 15; United Kingdom 15; Austria 12.
Columbium and tantalum: Tantalum metal including alloys, all forms	1	6	All to United States.
Copper metal including alloys:			
Scrap	25,111	37,357	West Germany 17,624; Belgium-Luxembourg 13,953; Italy 3,120.
Unwrought	14,670	10,753	France 6,642; West Germany 2,434; Belgium-Luxembourg 679.
Semimanufactures	32,799	42,107	West Germany 12,179; United States 7,686; Belgium-Luxembourg 4,782.
Germanium metal including alloys, all forms	1	NA	
Gold[1] thousand troy ounces	552	575	France 246; Belgium-Luxembourg 154.
Iron and steel:			
Ore and concentrate, except roasted pyrite thousand tons	96	30	West Germany 24; France 2; Italy 2.
Metal:			
Scrap do	1,096	1,104	West Germany 752; Belgium-Luxembourg 146; Spain 94.
Pig iron and ferroalloys[2] do	14	16	West Germany 12; France 2; Belgium-Luxembourg 1.
Steel, primary forms do	1,484	1,716	West Germany 490; United Kingdom 377; Belgium-Luxembourg 255.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	522	540	West Germany 129; Belgium-Luxembourg 105; United Kingdom 71.
Universals, plates, sheets do	1,475	1,600	United Kingdom 380; West Germany 242; Belgium-Luxembourg 199.
Hoop and strip do	84	108	West Germany 67; Belgium-Luxembourg 10; France 7.
Rails and accessories do	30	38	Italy 15; West Germany 13; Mexico 4.
Wire do	40	49	France 16; West Germany 11; Belgium-Luxembourg 10.
Tubes, pipes, fittings do	444	388	West Germany 120; United Kingdom 52; Belgium-Luxembourg 44.
Castings and forgings, rough do	9	7	West Germany 5.
Lead:			
Oxides	165	551	Italy 175; Algeria 125; West Germany 87.
Metal:			
Scrap	11,611	16,761	West Germany 9,568; Belgium-Luxembourg 3,476; Italy 1,934.
Unwrought	24,594	22,913	West Germany 12,560; Poland 3,319; United States 2,379.
Semimanufactures	2,113	1,942	Belgium-Luxembourg 592; Norway 457; United Kingdom 304.
Magnesium metal including alloys:			
Scrap	1,364	2,197	West Germany 1,103; United States 704; Italy 206.
Unwrought and semimanufactures	2,408	2,209	West Germany 1,105.

See footnotes at end of table.

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Table 2.—Netherlands: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Manganese:			
Ore and concentrate	26,030	31,854	France 7,466; West Germany 5,214.
Oxide	102	63	Italy 45.
Mercury 76-pound flasks	1,247	2,292	West Germany 783; Iran 319.
Molybdenum metal including alloys, all forms	191	137	Belgium-Luxembourg 59; West Germany 34; Italy 20; United States 13.
Nickel:			
Ore and concentrate	324	392	West Germany 384.
Matte, speiss, similar materials	324	2,930	West Germany 750; Italy 743; Japan 743.
Oxide and hydroxide	38	83	West Germany 42; Belgium-Luxembourg 33.
Metal including alloys:			
Scrap	2,461	3,933	United Kingdom 1,496; West Germany 1,071; Spain 370.
Unwrought	3,713	2,538	Japan 743; Italy 740; West Germany 366.
Semimanufactures	4,788	3,764	Sweden 3,341.
Platinum-group metals including alloys, all forms troy ounces	5,691	7,073	West Germany 3,826; Switzerland 868; Japan 772.
Selenium, elemental	4	23	West Germany 16; Italy 2; Spain 2; United States 2.
Silver metal including alloys, all forms thousand troy ounces	12	7,423	Belgium-Luxembourg 4,268; France 1,762; Switzerland 322.
Tellurium and arsenic, elemental	30	50	France 41; Italy 5.
Tin:			
Oxide	9	4	Romania 3; Belgium-Luxembourg 1.
Metal including alloys:			
Scrap	434	742	United Kingdom 291; Belgium-Luxembourg 174; West Germany 133.
Unwrought	1,135	1,439	West Germany 617; Belgium-Luxembourg 334; United Kingdom 268.
Semimanufactures	523	583	West Germany 266; Belgium-Luxembourg 179.
Titanium dioxide	18,927	21,120	West Germany 4,420; France 3,530; Italy 3,176; Belgium-Luxembourg 2,896.
Tungsten:			
Ore and concentrate	1,254	1,239	West Germany 237; Switzerland 165; United Kingdom 165.
Metal including alloys, all forms	192	130	Belgium-Luxembourg 84; West Germany 24.
Zinc:			
Ore and concentrate	28,875	24,162	Belgium-Luxembourg 22,018; France 2,123.
Oxide	7,456	8,476	Belgium-Luxembourg 2,052; West Germany 957.
Metal including alloys:			
Scrap	7,457	5,158	West Germany 1,515; Belgium-Luxembourg 1,184; Pakistan 1,157.
Dust (blue powder)	1,230	1,632	NA.
Unwrought	90,247	129,078	United Kingdom 66,764; West Germany 18,175; France 12,850.
Semimanufactures	2,419	3,832	West Germany 2,902; Belgium-Luxembourg 433; France 229.
Other:			
Ores and concentrates	74,247	47,356	West Germany 14,178; France 7,752; United Kingdom 7,636.
Base metals including alloys, all forms	1,767	3,234	West Germany 2,228; United Kingdom 306; France 227.
Ash and residue containing nonferrous metals:			
Aluminum[3]	6,186	8,217	West Germany 4,962; France 3,255.
Lead	5,624	3,385	West Germany 1,084; Belgium-Luxembourg 1,063; Denmark 770.
Zinc	9,747	14,784	West Germany 6,904; Belgium-Luxembourg 4,517.
Other[3]	11,384	10,473	West Germany 4,507; Sweden 2,926.
Oxides, hydroxides, peroxides of metals	12	162	West Germany 64; United States 33; Turkey 24; France 18.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc.	5,062	6,809	West Germany 3,076.
Dust and powder of precious and semiprecious stones, including diamond thousand carats	2,390	756	West Germany 175; Japan 127; United States 95; Sweden 89.

See footnotes at end of table.

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Table 2.—Netherlands: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Abrasives, natural, n.e.s. —Continued			
Grinding and polishing stones	2,569	2,884	West Germany 803; United Kingdom 534; Belgium-Luxembourg 375.
Asbestos	189	199	NA.
Barite and witherite	81,568	103,021	West Germany 46,940; U.S.S.R. 24,197; East Germany 19,264; Norway 10,957.
Borates, crude, natural	336,722	327,132	West Germany 73,776; France 59,733; United Kingdom 55,299.
Cement	205,967	203,175	West Germany 101,623; Belgium-Luxembourg 62,776; Saudi Arabia 16,807.
Chalk	27,193	31,168	Belgium-Luxembourg 30,900.
Clays and clay products:			
Crude:			
Kaolin	52,192	71,535	Belgium-Luxembourg 69,754.
Refractory	3,370	5,214	Belgium-Luxembourg 3,241; United Kingdom 546.
Other, including bentonite	125,338	118,945	West Germany 75,416; Belgium-Luxembourg 28,341.
Products:			
Refractory (including nonclay brick)	32,676	38,650	West Germany 9,697; France 6,660; Republic of South Africa 3,477.
Nonrefractory thousand tons	671	743	West Germany 494; Belgium-Luxembourg 210; France 16.
Diamond, not set or strung, except dust and powder thousand carats	1,478	5,149	United Kingdom 2,706; Ireland 777; United States 522.
Diatomite and other infusorial earth	222	207	West Germany 64; Ghana 48; Nigeria 29.
Feldspar, fluorspar, leucite	421	2,383	Belgium-Luxembourg 1,502; Greece 595.
Fertilizer materials:			
Crude:			
Phosphatic	25,998	73,696	West Germany 39,823; Belgium-Luxembourg 25,029; France 5,134.
Other	44,891	82,569	Belgium-Luxembourg 58,539; West Germany 12,811; France 10,863.
Manufactured:			
Nitrogenous thousand tons	2,031	2,604	United States 562; France 259; India 244.
Phosphatic (including Thomas slag) do	216	187	France 68; West Germany 42; Belgium-Luxembourg 17.
Potassic (K_2O content)	2,773	705	United Kingdom 315; Tunisia 147; West Germany 107.
Other, including mixed thousand tons	731	788	France 338; West Germany 48; Belgium-Luxembourg 20.
Ammonia, anhydrous do	678	546	Belgium-Luxembourg 194; France 91; United Kingdom 74; Ireland 69.
Graphite, natural	217	493	West Germany 254; United Kingdom 170.
Gypsum and plasters	11,081	13,538	Belgium-Luxembourg 13,083.
Lime	3,834	3,875	NA.
Magnesite	39,086	36,029	West Germany 18,296; Belgium-Luxembourg 4,144.
Mica	1,143	543	West Germany 135.
Pigments, mineral, including processed iron oxides	2,301	3,454	West Germany 1,653; United Kingdom 689.
Precious and semiprecious stones, except diamond kilograms	25,050	62	West Germany 14.
Salt thousand tons	1,897	2,072	West Germany 647; Belgium-Luxembourg 533; Sweden 474.
Stone, sand and gravel:			
Dimension stone:			
Unworked and partly worked	19,987	4,396	West Germany 2,937; Belgium-Luxembourg 812.
Worked	9,261	10,654	West Germany 7,363; Belgium-Luxembourg 2,733; Norway 245.
Dolomite	19,147	14,161	West Germany 7,279; Belgium-Luxembourg 5,498.
Gravel and crushed stone thousand tons	333	464	Belgium-Luxembourg 283; West Germany 181.
Limestone	2,554	3,163	Belgium-Luxembourg 2,984.
Quartz and quartzite	11,275	10,570	West Germany 6,918; Belgium-Luxembourg 2,491.
Sand, excluding metal bearing thousand tons	8,578	11,207	Belgium-Luxembourg 10,756.
Sulfur:			
Elemental	7,038	2	NA.
Sulfur dioxide	720	862	Belgium-Luxembourg 191.
Sulfuric acid	164,265	140,066	Belgium-Luxembourg 42,885; West Germany 14,302.

See footnotes at end of table.

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Table 2.—Netherlands: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Talc and steatite	1,556	2,051	Italy 693; Belgium-Luxembourg 515; West Germany 327.
Other:			
Oxides and hydroxides of magnesium, strontium, barium	205	564	West Germany 329; Portugal 79.
Slag, dross, and similar waste, not metal bearing:			
From iron and steel manufacture thousand tons	65	87	West Germany 80.
Other do	84	64	Belgium-Luxembourg 40; United Kingdom 10; France 7.
Unspecified do	210	229	West Germany 80; Belgium-Luxembourg 71; France 65.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	5	31	NA.
Carbon black	67,807	77,706	France 38,583; West Germany 17,260; Belgium-Luxembourg 10,246.
Coal and coal briquets:			
Anthracite and bituminous coal thousand tons	287	460	West Germany 317; Belgium-Luxembourg 122; France 17.
Briquets of anthracite and bituminous coal	NA	4,531	Belgium-Luxembourg 4,483.
Lignite thousand tons	--	1,165	NA.
Coke and semicoke do	653	659	France 343; Belgium-Luxembourg 141; West Germany 97.
Gas:			
Manufactured do	NA	222	Belgium-Luxembourg 163; United Kingdom 31.
Natural billion cubic feet	1,821	2,026	West Germany 979; Belgium-Luxembourg 426; France 386.
Hydrogen, helium, rare gases	15,449	20,688	West Germany 9,323; Belgium-Luxembourg 6,248; France 2,544.
Peat and peat briquets thousand tons	58	82	Belgium-Luxembourg 57; France 17; West Germany 7.
Petroleum:[4]			
Crude thousand 42-gallon barrels	5,439	--	
Refinery products:			
Gasoline do	60,843	75,404	Belgium-Luxembourg 8,322; Sweden 2,730; Denmark 2,499.
Kerosine and jet fuel do	19,274	21,103	United Kingdom 4,479; Denmark 2,315; Sweden 652.
Distillate fuel oil do	102,292	110,505	West Germany 66,424; Belgium-Luxembourg 14,629; United Kingdom 4,335.
Residual fuel oil do	122,411	125,514	Belgium-Luxembourg 16,290; West Germany 14,519; Denmark 7,532.
Lubricants do	3,057	3,681	United Kingdom 549; Belgium-Luxembourg 475; Sweden 271.
Other:			
Liquefied petroleum gas do	5,290	5,232	Belgium-Luxembourg 3,028; Portugal 777.
Mineral jelly and wax do	504	512	West Germany 183; Morocco 135; United Kingdom 109.
Bituminous mixtures do	242	309	Sweden 85; West Germany 79; Norway 73.
Unspecified do	4,200	4,073	West Germany 1,290; Denmark 772; Norway 553.
Total do	318,113	346,333	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals thousand tons	459	470	West Germany 200; United Kingdom 123; France 39.

NA Not available.
[1]Excluding monetary gold.
[2]Includes sponge iron, shot, grit, pellets, powder, spiegeleisen, and ferromanganese.
[3]Exports to Belgium-Luxembourg are included in "Other."
[4]Including bunkers.

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Table 3.—Netherlands: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite	152,732	130,828	Greece 116,986; Guyana 13,173.
Alumina	576,816	547,233	Surinam 186,253; Greece 169,090; France 132,121.
Metal including alloys:			
Scrap	24,728	28,341	West Germany 18,828; Belgium-Luxembourg 2,648; France 2,203.
Unwrought	121,389	162,108	Norway 73,599; United Kingdom 36,294; West Germany 30,399.
Semimanufactures	63,885	97,027	West Germany 41,464; Belgium-Luxembourg 24,364; France 10,275.
Antimony metal including alloys, all forms	43	47	Italy 20; Belgium-Luxembourg 14; United Kingdom 6.
Arsenic oxides and acids	740	645	France 471; Belgium-Luxembourg 71; People's Republic of China 68.
Beryllium metal including alloys, all forms	4	2	West Germany 1.
Bismuth metal including alloys, all forms	130	49	Belgium-Luxembourg 18; China 4; Japan 4; United Kingdom 4.
Cadmium metal including alloys, all forms	73	169	Japan 50; West Germany 38; Belgium-Luxembourg 25.
Chromium:			
Chromite	38,834	21,022	Mozambique 12,945; Republic of South Africa 7,837.
Oxides and hydroxides	880	1,118	West Germany 507; U.S.S.R. 310; France 214.
Cobalt:			
Oxides and hydroxides	186	412	Belgium-Luxembourg 265; United Kingdom 120.
Metal including alloys, all forms	76	84	Belgium-Luxembourg 36; West Germany 23; France 10; United States 8.
Columbium and tantalum: Tantalum	3	1	NA.
Copper:			
Copper sulfate	2,520	3,913	Belgium-Luxembourg 1,656; France 1,105; U.S.S.R. 440.
Metal including alloys:			
Scrap	11,975	--	
Unwrought	49,529	60,596	Belgium-Luxembourg 19,578; U.S.S.R. 7,509; Chile 7,451.
Semimanufactures	65,013	74,075	Belgium-Luxembourg 30,241; West Germany 29,330; France 7,934.
Gold[1] thousand troy ounces	2,409	1,646	West Germany 595; Switzerland 403; United States 258; France 252.
Iron and steel:			
Ore and concentrate, except roasted pyrite thousand tons	7,369	6,528	Sweden 1,711; Brazil 1,672; Canada 1,184.
Metal:			
Scrap do	205	199	West Germany 103; Belgium-Luxembourg 40; United Kingdom 36.
Pig iron[2] do	106	104	West Germany 31; Norway 23; France 12.
Ferroalloys do	47	53	Norway 19; France 8; West Germany 8.
Steel, primary forms do	372	528	Belgium-Luxembourg 262; Norway 159; West Germany 72.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	1,140	1,461	Belgium-Luxembourg 675; West Germany 523; France 147.
Universals, plates, sheets do	1,059	1,090	Belgium-Luxembourg 455; West Germany 421; France 56.
Hoop and strip do	32,368	238	West Germany 165; Belgium-Luxembourg 32; France 30.
Rails and accessories do	47	43	West Germany 31; France 12.
Wire do	82	121	Belgium-Luxembourg 66; West Germany 48; France 3.
Tubes, pipes, fittings do	784	603	West Germany 384; France 73; Belgium-Luxembourg 55.
Castings and forgings, rough do	13	12	West Germany 6; Belgium-Luxembourg 5.
Lead:			
Oxides	9,378	11,971	West Germany 5,944; France 3,069; Belgium-Luxembourg 2,411.

See footnotes at end of table.

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Table 3.—Netherlands: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Lead —Continued			
Metal including alloys:			
Scrap	19,291	9,805	West Germany 5,772; France 2,023.
Unwrought	43,879	51,857	United Kingdom 15,554; Belgium-Luxembourg 12,331; Australia 10,547.
Semimanufactures	2,664	2,562	Belgium-Luxembourg 1,415; West Germany 797.
Magnesium metal including alloys:			
Scrap	948	1,230	West Germany 538; France 174; Norway 130.
Unwrought	2,555	1,907	Norway 739; United States 472; France 418.
Semimanufactures	137	141	France 51; West Germany 40; United Kingdom 24.
Manganese:			
Ore and concentrate	47,330	45,654	Belgium-Luxembourg 4,110; West Germany 1,099; France 398.
Oxide	789	797	Belgium-Luxembourg 717.
Mercury 76-pound flasks	2,727	3,017	Algeria 1,421; Spain 725; Italy 406.
Molybdenum metal including alloys, all forms	172	201	West Germany 68; France 65; Belgium-Luxembourg 35.
Nickel:			
Matte, speiss, similar materials	384	446	Cuba 439.
Metal including alloys:			
Scrap	2,396	1,576	West Germany 853; United Kingdom 288; United States 153.
Unwrought	4,394	3,605	United Kingdom 1,103; Republic of South Africa 694; Cuba 439.
Semimanufactures	4,261	3,696	Sweden 1,828; West Germany 897; Switzerland 259.
Platinum-group metals including alloys, all forms thousand troy ounces	231	35	West Germany 12; Switzerland 8; United Kingdom 7; France 4.
Silver metal including alloys, all forms do	337	681	West Germany 567; United States 102.
Tellurium and arsenic, elemental	29	59	United States 50; Sweden 5.
Tin:			
Ore and concentrate	3,083	2,882	Republic of South Africa 2,014; Peru 697; Burma 147.
Oxide	41	82	United Kingdom 52; West Germany 30.
Metal including alloys:			
Scrap	540	771	West Germany 539; France 123; Belgium-Luxembourg 55.
Unwrought	4,362	5,764	Malaysia 1,517; United Kingdom 1,102; People's Republic of China 1,000.
Semimanufactures	88	98	West Germany 77; United Kingdom 10.
Titanium:			
Ore and concentrate (ilmenite)	28,063	11,020	Australia 10,543.
Oxide	3,885	7,561	West Germany 3,671; Italy 1,154; United Kingdom 847; France 787.
Metal including alloys, all forms	189	264	United States 124; Yugoslavia 53.
Tungsten:			
Ore and concentrate	1,880	3,218	Peru 2,228; Burma 416; Republic of South Africa 277.
Metal including alloys, all forms	243	161	Belgium-Luxembourg 73; West Germany 55; United Kingdom 16.
Zinc:			
Ore and concentrate	295,722	309,138	Australia 169,533; Canada 58,167; Peru 30,271.
Oxides	3,022	3,644	United Kingdom 1,144; Belgium-Luxembourg 1,049; West Germany 776; France 485.
Metal including alloys:			
Scrap	4,031	4,476	West Germany 3,050; United Kingdom 398; Belgium-Luxembourg 319.
Dust (blue powder)	8,904	7,515	Belgium-Luxembourg 5,771; West Germany 1,453; United Kingdom 207.
Unwrought	26,450	28,777	West Germany 10,035; Belgium-Luxembourg 4,577; Zambia 4,155.
Semimanufactures	3,203	4,955	West Germany 2,801; Belgium-Luxembourg 1,896; France 182.

See footnotes at end of table.

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Table 3.—Netherlands: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Other:			
Ores and concentrates of nonferrous metals	611,226	207,988	Greece 116,986; Australia 26,220; United States 21,298.
Ash and residue containing nonferrous metals:			
Lead	3,368	10,203	Belgium-Luxembourg 9,154.
Zinc	14,192	13,480	West Germany 9,900; East Germany 2,207.
Other	35,223	71,080	Canada 54,402; West Germany 9,883.
Metals including alloys, all forms:			
Selenium	15	32	West Germany 14; United Kingdom 8; Japan 7.
Silicon, elemental	2,599	4,580	Republic of South Africa 2,276; France 823; Spain 648.
Alkali, alkaline-earth, rare-earth metals	NA	354	France 299; West Germany 54.
Base metals including alloys, all forms	2,310	2,955	Mozambique 904; Republic of South Africa 803; France 332.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc. thousand tons	561	297	West Germany 290.
Dust and powder of precious and semiprecious stones thousand carats	1,997	1,126	Ireland 804; Switzerland 113.
Grinding and polishing stones	2,310	2,478	West Germany 1,331; France 231; Austria 229.
Asbestos	35,852	49,466	Canada 39,720; Italy 4,394; U.S.S.R. 2,314.
Barite and witherite	118,829	121,874	Peru 87,693; West Germany 33,274.
Boron materials:			
Crude natural borates	384,768	334,059	United States 323,931.
Oxide and acid	2,379	2,875	Turkey 1,208; France 641; United States 516; Belgium-Luxembourg 330.
Cement thousand tons	2,056	2,601	West Germany 1,562; Belgium-Luxembourg 1,022.
Chalk	93,296	108,205	France 55,616; Belgium-Luxembourg 37,829; West Germany 12,996.
Clays and clay products:			
Crude clays:			
Bentonite[3] thousand tons	42	31	West Germany 14; United States 9; Greece 6.
Kaolin do	309	378	United Kingdom 174; West Germany 134.
Refractory do	26	31	West Germany 15; France 7; United Kingdom 4.
Products:			
Refractory (including nonclay brick) do	66	54	West Germany 29; United Kingdom 12; Austria 5.
Nonrefractory do	218	275	West Germany 142; Italy 49; Belgium-Luxembourg 45.
Cryolite and chiolite	641	1,092	Denmark 1,082.
Diamond, all types thousand carats	1,811	14,656	United Kingdom 2,422; Ireland 2,047; Burundi 1,835.
Diatomite and other infusorial earth	15,482	15,964	Denmark 8,643; West Germany 2,700; France 1,620.
Feldspar, fluorspar, leucite	59,935	81,477	Belgium-Luxembourg 8,168.
Fertilizer materials:			
Crude:			
Nitrogenous	12,900	25,092	All from Chile.
Phosphatic thousand tons	1,591	1,763	United States 591; Morocco 579; Togo 497.
Potassic salts do	9	7	All from West Germany.
Other do	57	56	West Germany 50; Belgium-Luxembourg 4; France 2.
Manufactured:			
Nitrogenous do	112	236	Belgium-Luxembourg 84; Portugal 55; West Germany 33.
Phosphatic:			
Thomas slag (P_2O_5 content) do	16	165	All from Belgium-Luxembourg.
Other (P_2O_5 content) do	39	8	Tunisia 4; Belgium-Luxembourg 2; United States 2.
Potassic do	309	365	West Germany 124; East Germany 50; Belgium-Luxembourg 48.
Other, including mixed do	52	74	West Germany 33; Belgium-Luxembourg 22; France 9.
Ammonia	4,854	2,562	United Kingdom 1,655; France 766.

See footnotes at end of table.

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Table 3.—Netherlands: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Graphite, natural	388	479	People's Republic of China 225; West Germany 147; United Kingdom 53.
Gypsum and plasters thousand tons	377	363	West Germany 169; France 145; Belgium-Luxembourg 41.
Lime do	874	903	West Germany 456; Belgium-Luxembourg 447.
Magnesite	76,007	70,926	Greece 43,550; Austria 9,469.
Mica:			
Crude, including splittings and waste	1,653	2,215	People's Republic of China 700; Republic of South Africa 549; Norway 379; United Kingdom 325.
Worked, including agglomerated splittings	36	55	Switzerland 15; Belgium-Luxembourg 14; United Kingdom 2.
Phosphorus, elemental	47	404	West Germany 384.
Pigments, mineral:			
Natural, crude	1,517	2,326	West Germany 928; Austria 877; Cyprus 271.
Iron oxides, processed	10,476	13,586	West Germany 12,322.
Precious and semiprecious stones, except diamond kilograms	43,228	6,356	Japan 5,181; United Kingdom 694.
Pyrite, gross weight	229	75	West Germany 25.
Salt	24,318	32,123	West Germany 16,534; Belgium-Luxembourg 9,151; Sweden 4,815.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	152,315	148,762	West Germany 83,017; Belgium-Luxembourg 60,466.
Caustic potash	1,447	1,587	West Germany 869; France 518.
Stone, sand and gravel:			
Dimension stone:			
Unworked and partly worked thousand tons	330	443	West Germany 309; Belgium-Luxembourg 66.
Worked	36,760	46,791	Italy 22,137; West Germany 9,802; Belgium-Luxembourg 6,340.
Dolomite thousand tons	797	820	Belgium-Luxembourg 716; West Germany 82.
Gravel and crushed rock do	4,171	3,911	West Germany 2,592; Belgium-Luxembourg 897.
Limestone do	750	739	Belgium-Luxembourg 670.
Quartz and quartzite	28,097	31,342	Belgium-Luxembourg 15,635; Norway 12,175.
Sand, excluding metal bearing thousand tons	7,349	7,126	West Germany 6,309.
Sulfur:			
Elemental	r348	277	West Germany 219; Belgium-Luxembourg 47.
Sulfur dioxide	4	19	NA.
Sulfuric acid	156,527	144,926	West Germany 122,812; Poland 11,933; Norway 9,470.
Talc and steatite	13,999	17,183	Austria 7,663; Norway 4,880.
Other:			
Crude thousand tons	1,541	1,307	West Germany 1,105; Belgium-Luxembourg 174.
Slag, dross, and similar waste, not metal bearing:			
From iron and steel manufacture do	2,180	2,281	West Germany 2,151.
Slag and ash, n.e.s do	593	582	West Germany 494; Belgium-Luxembourg 88.
Oxides of barium, strontium, magnesium	1,127	1,879	West Germany 980; U.S.S.R. 230; United Kingdom 190.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	3,570	4,092	United States 1,789; West Germany 1,443; France 741.
Carbon black (including gas carbon)	9,731	9,745	West Germany 7,624.
Coal and coal briquets:			
Anthracite and bituminous coal thousand tons	4,144	4,910	United States 2,413; West Germany 982; Poland 651.
Briquets of anthracite and bituminous coal do	8	5	All from West Germany.
Lignite and lignite briquets do	13	13	West Germany 10; East Germany 3.
Coke and semicoke do	497	292	West Germany 193; United Kingdom 30; East Germany 24.
Gas, natural thousand cubic feet	71	35	NA.
Peat and peat briquets thousand tons	217	311	West Germany 304; Finland 4; U.S.S.R. 2.

See footnotes at end of table.

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Table 3.—Netherlands: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum:[4]			
Crude ____ thousand 42-gallon barrels__	372,498	466,616	Iran 131,606; Saudi Arabia 118,934; Nigeria 72,470.
Refinery products:			
Gasoline ____ do____	38,148	46,852	Belgium-Luxembourg 6,243; Kuwait 4,150; Romania 3,945.
Kerosine and jet fuel ____ do____	2,736	3,071	Belgium-Luxembourg 1,092; Italy 440; U.S.S.R. 308.
Distillate fuel oil ____ do____	25,454	20,776	U.S.S.R. 7,000; United Kingdom 5,826; Bahamas 1,511.
Residual fuel oil ____ do____	12,294	9,810	Belgium-Luxembourg 3,183; Saudi Arabia 2,552; United Kingdom 1,048.
Lubricants ____ do____	1,592	1,861	Belgium-Luxembourg 541; United Kingdom 299; France 266.
Other:			
Liquefied petroleum gas ____ do____	487	2,110	West Germany 545; East Germany 533; Belgium-Luxembourg 523.
Mineral jelly and wax ____ do____	220	296	West Germany 106; France 87; United Kingdom 53.
Bituminous mixtures ____ do____	158	353	West Germany 178; Belgium-Luxembourg 166.
Unspecified ____ do____	5,532	4,632	United States 1,795; West Germany 1,597.
Total ____ do____	86,621	89,761	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals ____ thousand tons__	192	43	Belgium-Luxembourg 22; France 11; West Germany 6.

[r] Revised. NA Not available.
[1] Excluding monetary gold.
[2] Includes spiegeleisen, sponge iron, shot, grit, and pellets.
[3] Excludes imports of bentonite from Belgium-Luxembourg.
[4] Including bunkers.

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Table 4.—Netherlands: Mineral trade with the United States, 1976[1]

Commodity	Exports		Imports	
	Quantity (metric tons)	Value, thousands	Quantity (metric tons)	Value, thousands
METALS				
Aluminum metal including alloys	1,481	$2,944	4,528	$8,067
Copper metal including alloys	7,939	13,120	6,708	12,981
Iron and steel metal:				
Scrap	13,581	155	9,406	4,439
Pig iron	--	--	285	540
Ferroalloys	--	--	1,310	2,453
Steel, primary forms	21	20	261	107
Semimanufactures:				
Bars and angles	13,337	3,949	2,232	734
Plates and sheets	341,669	88,670	14,786	4,150
Hoop and strip	(2)	2	1,679	1,821
Rails	--	--	NA	2
Wire	392	179	171	475
Tubes and pipes	328	341	3,697	8,922
Castings and forgings	26	3	367	1,026
Lead metal including alloys	2,000	721	30	18
Lead-zinc ores and concentrates	--	--	5,358	838
Molybdenum ore and concentrate	--	--	12,695	85,102
Nickel metal including alloys	39	300	5,232	24,267
Platinum-group metals and silver:				
Ores	18	249	NA	84
Platinum-group metals	NA	329	NA	344
Radioactive and associated materials	3	227	335	5,030
Tin metal including alloys	NA	2	--	--
Uranium metal including alloys	--	--	NA	1
Zinc metal including alloys	8,758	6,587	2,619	1,954
Other nonferrous metals:				
Ores and concentrates, n.e.s.	10	114	46,398	5,796
Metals:				
Base metals including alloys, n.e.s	509	1,658	334	2,252
Scrap	1,116	1,098	2,497	3,316
NONMETALS				
Abrasives, natural, including diamond	10	87	3,441	585
Clays and refractory materials	185	27	91,549	6,730
Diamond and precious stones:				
Industrial diamond	NA	1,588	NA	992
Gem diamond and precious stones	NA	33,796	15	40,073
Fertilizer materials:				
Crude, phosphatic	--	--	695,448	21,499
Ammonia, anhydrous	24,446	3,607	3,715	4,407
Quartz, mica, feldspar, etc	171	42	--	--
Salt, sodium chloride	(2)	(2)	--	--
Stone, sand and gravel:				
Dimension stone	36	10	--	--
Crushed and broken stone, sand and gravel	4	2	709	220
Sulfur:				
Sulfur and unroasted pyrites	--	--	287,184	15,249
Sulfuric acid	--	--	141	17
Other, crude	9	10	329,874	48,108
MINERAL FUELS AND RELATED MATERIALS				
Asphalt, natural	--	--	1,890	272
Coal, all types	3	1	3,184,397	143,785
Coke	15,559	1,449	156,495	7,449
Gas, natural and manufactured	NA	1	--	--
Petroleum:				
Crude and partly refined	97,775	12,221	--	--
Refinery products:				
Jet fuel	15,074	1,813	NA	128
Distillate fuel oil	10,289	757	--	--
Residual fuel oil	468,616	33,544	--	--
Lubricants	19	4	27,601	9,825
Petroleum jelly and mineral waxes	1,095	490	2,982	1,448
Petroleum coke, asphalt, etc	12,998	1,295	1,369,629	69,597
Total	XX	211,412	XX	545,103

NA Not available. XX Not applicable.
[1]Data may differ from those reported elsewhere in this chapter owing to a difference in source.
[2]Less than 1/2 unit.

Source: U.S. Department of Commerce, Bureau of the Census.

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COMMODITY REVIEW

METALS

Aluminum.—A serious fire in the electrical switching station of Aluminium Delfzijl N.V. halted all smelter production for 3-1/2 months. Otherwise the industry was fully occupied, although a slackening of demand was noted in the second half of the year.

The two Dutch smelters, based on domestic natural gas, continued as important suppliers of both the domestic and export markets. The Aluminum Delfzijl smelter, located on the Ems estuary in the northeast, had a capacity of about 106,000 tons per year. The larger plant, Péchiney Nederland N.V.'s smelter at Vlissingen (or Flushing), had a capacity of 187,000 tons per year.

Alumina was imported from Surinam, Greece, and France. The Dutch Government had an agreement with the Surinam Government to develop new bauxite areas in western Surinam, but agreement on financing costs was still to be worked out.

Iron and Steel.—The Netherlands' major steel producer, Hoogovens IJmuiden B.V., finally decided to cut its expansion plans as a result of the continuing recession in the European steel industry. Plans to reach 11-million-ton capacity by 1985 were abandoned, and production was to be kept at the present level of about 5 million tons per year, well within the 7.3-million-ton capacity. Planned capital spending was also cut to $30 million per year, from an original level of $80 million to $120 million, and the work force was to be trimmed by some 2,500 out of 23,000 workers, of which 600 were to be production-line employees. The company expected a loss of $160 million to $200 million in 1977 but hoped to be in the black by 1980.

Hoogovens IJmuiden was owned by Estel N.V. Hoesch-Hoogovens, a Dutch-West German group headquartered at Nijmegen that also controlled the Hoesch steel plants in and around Dortmund, Federal Republic of Germany. Hoogovens' main plant on the coast at IJmuiden, west of Amsterdam, produced over 90% of the Netherlands' crude steel, with the remainder contributed almost entirely by NKF Staal B.V. at Alblasserdam, near Rotterdam, in which August Thyssen Hütte AG of the Federal Republic of Germany was a main shareholder. The third Dutch producer, N.V. Staalgietwerk SMDK at Utrecht, was liquidated during the year by the main shareholders, Hoogovens and Sambre et Meuse of France, because of lack of demand for its main product, castings for the shipbuilding industry.

Magnesium.—Billiton B.V. proceeded with its planned development of a 100,000-ton-per-year magnesium oxide plant at Veendam, scheduled to come onstream in 1981. Feed for the plant was to come from solution mining in the Provinces of Groningen and Drente, near Veendam; the latest estimate of plant requirements was about 600,000 tons of brines per year. The project was activated under a letter of intent from the two new partners, Billiton International Metals B.V. and Dutch Government-owned Northern Development Co.

Billiton's original partner in the solution mining venture, Norsk Hydro A/S of Oslo, Norway, withdrew and postponed plans to commence work on a 100,000-ton magnesium plant in Mongstad, Norway, which was to have taken part of the output of the Veendam solution mine.

NONMETALS

Cement.—One cement plant, with an annual kiln capacity of 2,640,000 tons, was operated at Maastricht by Eerste Nederlandsche Cement Industrie N.V. Two clinker-grinding plants were operated, one at IJmuiden by Cementfabriek IJmuiden B.V. and one at Rosenburg (Rotterdam) by Cement Fabriek Rosenburg B.V.

Salt.—All Dutch salt production came from a single company—Akzo Zout Chemie Nederland B.V., a subsidiary of the Akzo N.V. firm, which is international in extent and controls International Salt Co. of the United States. Production was centered at Hengelo and Delfzijl, both near the West German border. The salt was all produced by solution mining and vacuum evaporation, and much of it was exported. It was also converted into soda ash and electrolytic products, as well as several grades of salt.

MINERAL FUELS

Statements by high Government officials appeared to be harbingers of renewed interest in a stronger Dutch energy policy. The Prime Minister in June called for "an intensive energy conservation program" in view of the gradual exhaustion of the na-

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tion's natural gas reserves. Not by coincidence, the Netherlands started to import natural gas from Norway at the same time. In May, the Minister of Economics emphasized the urgency of overcoming the anticipated gap between energy supply and demand and stressed the need to develop the nuclear alternative.

The Minister said that all estimates point to an oil shortage in the mid-1980's, only part of which could be compensated for by coal. Consequently, the EEC would run irresponsible strategic and political risks, as well as suffer substantial economic losses, if little or no nuclear energy were used. He declared that the Netherlands should make a decision to obtain an additional 3,000 megawatts from nuclear energy by the mid-1980's.

Energy balances for the Netherlands for 1975 and 1976 are given in table 5.

Table 5.—Netherlands: Supply and apparent consumption of fuels and power for 1975 and 1976

(Million tons of standard coal equivalent[1])

	Total energy	Coal and coke	Petroleum and refinery products	Natural gas	Nuclear power
1975:					
Production	111.8	--	2.2	109.1	0.5
Imports	97.1	4.7	92.4	--	--
Exports	107.4	.9	47.3	[2]59.2	--
Apparent consumption	101.5	3.8	[3]47.3	49.9	.5
1976:					
Production	113.7	--	2.3	110.2	1.2
Imports	114.7	5.1	109.6	--	--
Exports	132.4	.6	70.6	[2]61.2	--
Apparent consumption	[3]96.0	4.5	[3]41.3	49.0	1.2

[1]1 ton standard coal equivalent (SCE)=7,000,000 kilocalories.
[2]Exports of electricity.
[3]Includes refinery fuel and losses.

Source: International Energy Agency, Organization for Economic Cooperation and Development (OECD). Energy Balances of OECD Countries, 1974/1976, Paris. 1978.

Coal.—Following closure of the last Dutch coal mine a few years ago, the Government was concerned to secure a supply of coal, especially coking coal, from abroad. In March, a contract was signed with Poland for the import of 750,000 tons annually of coking coal for a period of 10 years. This amount would be about 20% of total coking coal needs; over half will be used by Hoogovens. The total bill was expected to be about $400 million, of which about $40 million would be paid by shipments of steel from Hoogovens.

Establishment of a large coal terminal on the reclaimed Meuse flats was planned by the Rotterdam Port Authority; it could be used by deep-draft coal carriers from overseas.

Natural Gas.—The Netherlands, the world's largest natural gas exporter, started to import gas from Norway in 1977 at a rate of 2.5 billion cubic meters per year and also concluded a 20-year contract with Algeria in June for the delivery of a total of 80 billion cubic meters of liquefied natural gas (LNG) starting in 1984. Exploratory negotiations were also underway with Nigerian producers for the purchase of further supplies of LNG.

Behind these seemingly anomalous developments was the supply position in the Netherlands. During 1976, proven reserves had fallen from 1.85 billion cubic meters to 1.76 billion cubic meters, the first significant drop recorded, and by mid-1977 another small drop was reported. Large long-term export contracts had been concluded at favorable prices in the 1960's when future competition from nuclear energy was feared and before the energy crisis had become acute. By 1977, it was apparent that to cover long-term commitments and growing domestic requirements, about 500 billion cubic meters of additional reserves, or one-third more than present reserves, would be required. N.V. Nederlandse Gasunie, the sole distributor of natural gas in the Netherlands and owned by the Dutch Government (10%), DSM (40%), Shell Nederland N.V. (25%), and Esso Nederland B.V. (25%), therefore concluded that it was essential to obtain additional supplies from foreign sources while exploration went on for

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large volumes of reserves. The price to be paid for this imported gas from both sources was unrevealed but was considerably higher than the export contract prices, and a prime objective of Gasunie was to renegotiate the latter. The Dutch Government was considering invoking a 1974 law that enabled it to step between Gasunie and the customers in the case of a price dispute, although foreign customers were expected to object.

It was expected that the Maasvlakte, a reclaimed area at the mouth of the Rhine River west of Rotterdam, would be chosen as the site for the storage and distribution plant to process the Algerian LNG; early in 1978 it was approved by the Dutch Cabinet, but further approval of the Rhine Mouth Authority was required. The site is adjacent to Gasunie's recently completed natural gas liquefaction and storage plant, which is used to bridge peak loads.

The low-cost Groningen field supplied about 95% of domestic production of natural gas in 1977, but offshore production, which started in 1975, reached about 5 billion cubic meters and was increasing rapidly. It was estimated that by 1980 offshore supplies would reach 10 billion cubic meters annually and would cover 20% of domestic demand. Blocks producing in 1977 were L10 and L11, operated by Placid International Oil Ltd; K13, operated by Pennzoil Nederland Co.; and L7, operated by Petroland B.V. Production licenses were granted for a number of small deposits in Blocks K8, K11, L13, and K15.

The major gas producer in the Netherlands was Nederlandse Aardolie Maatschappij B.V. (owned 50% by the Royal Dutch/Shell Group and 50% by Exxon Corp.), which operated the Groningen field and several smaller fields.

Petroleum.—Esso announced plans to convert a distillation unit to a 50,000-barrel-per-day viscosity breaker unit, to be completed in 1978. In this it joined British Petroleum Maatschappij Nederland N.V. (BP) and Shell, which earlier had announced plans to increase production of lighter products. All Dutch refineries were operating far below capacity, a fate shared by the majority of European refineries. The goal of a change in product mix to the lighter end of the barrel was motivated by a belief that demand would grow more strongly for those products, particularly motor gasoline, although annual fluctuations would be sizable. Future expenditures by Dutch refineries would, therefore, concentrate on improving safety, restricting pollution, and modernizing secondary capacity.

The Oil Stock Act of 1976 was passed by the Dutch Parliament and took effect on April 1, 1977. It compelled the oil industry and independent importers to keep 90-day stocks of crude oil and petroleum products.

The second stage of the crude oil storage farm under construction by five major oil companies (Shell, Esso, Chevron, BP, and Total) on the Maasvlakte near Rotterdam was completed, increasing the total number of storage tanks to 36 and the aggregate capacity to 4.3 million cubic meters. In view of the current level of crude oil demand, expansion to the projected full capacity of 100 tanks was not expected before 1985. Total Dutch distilling capacity remained at about 100 million tons in eight refineries, of which five were near Rotterdam, two near Amsterdam, and one at Vlissingen Oost (or East Flushing).

The decline in Dutch crude oil production since the peak of 2.4 million tons (about 17 million barrels) in 1965 was to be reversed gradually in the next 12 years through greater use of steam injection and expanding the number of wells by over 90, which together would require substantial investments. Petroleum production from the time of the discovery of the Schoonebeek field in 1943 to mid-1977 totaled 315 million barrels. Of this, the Schoonebeek field, in the Schoonebeek concession on the West German border, produced 179 million barrels; the remainder was almost entirely from several fields in the Rijswijk concession around The Hague: Ijsselmonde-Ridderkerk, Wassenaar-Meyendel, De Lier-Munster, Zoetermeer, and Pynacker.

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[1]Supervisory physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Dutch guilders to U.S. dollars at the rate of 2.45 guilders = US$1.00.

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The Mineral Industry of New Zealand

By Walter C. Woodmansee[1]

Natural gas and associated condensate continued to dominate New Zealand's mineral industry in 1977 and are expected to play an increasingly important role in the national energy program. Development continued onshore at the Kapuni gasfield and offshore at the Maui gasfield. The Maui gasfield was expected to be in production in 1978. Private oil and gas exploration was curtailed, pending a new Government petroleum policy, but new Government-sponsored exploration was initiated. The Government also conducted an exploration program for coal that was designed to delineate additional assured reserves. Major new coal mines that will mechanized and more efficient than older mines were under development during the year. These mines will provide fuel for power stations.

In New Zealand's nonfuel mining sectors, pit and quarry activity for sand and gravel, stone, clays, and other construction materials was extensive throughout the country and contributed a large share of New Zealand's total mining revenues for 1977. In the metals industries, production capacity was being expanded by New Zealand's two operating iron sand companies and at the Nation's sole steelmaking plant.

Late in the year, following a joint decision by the Minister of Mines and the Minister of Lands, the Mining Act of 1973 was amended so that holders of prospecting licenses were no longer permitted to automatically convert their licenses to mining licenses for national park areas. Exploration in New Zealand's national parks was nearly halted by the National Park Authority as a result of this provision.

Conflicts between mining and conservation interests intensified during 1977. The conservationists considered environmental requirements inadequate or inappropriate to achieve conservation goals; they wanted total restrictions on exploration and mining in certain areas. Government agencies proposed new or enlarged reserved areas, such as national parks and wilderness areas.

Legislation was passed that established a Ministry of Energy to formulate and implement a national energy policy. The Minister of Energy was granted authority to control most energy prices and to advise and assist private industry in mineral exploration and development, often with Government participation. Levies were established on natural gas ($0.45 per gigajoule), coal ($2 per ton), and lignite ($1.50 per ton). A proposal for a $3-per-barrel petroleum levy was dropped when the oil companies threatened to abandon exploration if the levy was imposed.

Imports of crude oil and refinery products provided about one-third of New Zealand's national energy requirements. Planned development of coal, natural gas, hydroelectric power, and geothermal power were expected to reduce petroleum imports between 20% and 25% of the Nation's total energy requirements by 1990.

PRODUCTION

Value of 1977 production in the mining sector, including coal but not natural gas and condensate, was estimated at $139.7 million.[2] This production accounted for only 0.9% of New Zealand's gross national product, $15,419 million as estimated by the

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New Zealand Institute of Economic Research. The principal mineral products (in thousand dollars) were sand and gravel ($53,302); coal ($46,164); iron sand concentrate ($20,853); limestone for agriculture, roads, cement, and other industries ($12,375); clays for brick, tile, and pottery ($1,999); gold ($1,156); serpentine ($946); silica ($688); salt ($650); and dolomite ($451).

There were few significant production shifts during the year. However, significant increases were made in the production of sand and gravel — the principal mine product in terms of output value — and in the production of iron sands, gold, silver, salt, bentonite, and kaolin. A small amount of new production was recorded for copper and zinc ores, but sulfur production ceased. Production losses were noted for coal, smelter aluminum, fire clay, pumice, and dimension stone.

Table 1.—New Zealand: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Aluminum, smelter production	108,600	139,800	124,549
Copper ore and concentrate	--	--	154
Gold, mine output, metal content troy ounces	2,747	3,276	7,168
Iron and steel:			
Iron ore, gross weight	329	185	NA
Iron sand, gross weight[1]	2,297,056	2,473,487	2,771,312
Sponge iron thousand tons	[e]160	[e]50	12
Crude steel do	198	[e]200	124
Silver, mine output, metal content troy ounces	[r]3,000	498	7,572
Tungsten, mine output, metal content	--	[e]6	11
Zinc, ore and concentrate	--	--	132
NONMETALS			
Cement, hydraulic thousand tons	1,085	999	910
Clays:			
Bentonite	5,246	1,042	2,633
Fire clay	211,423	260,811	173,008
Kaolin (including china clay)	26,997	58,834	94,742
Diatomite	3,055	[e]3,000	1,113
Magnesite	791	805	557
Perlite	1,500	1,500	1,000
Pumice	37,857	50,232	28,550
Salt	40,000	43,000	53,000
Sand and gravel:			
Glass sand	147,738	142,955	146,486
Common sand and gravel[2] thousand tons	22,628	20,881	21,477
Stone:			
Dolomite	13,598	23,129	23,070
Greenstone	[e]6	6	30
Limestone and marl:			
For agriculture thousand tons	1,502	1,686	1,732
For roads do	NA	274	308
For industry, except cement do	125	165	170
For cement do	1,838	1,674	1,590
Serpentine do	60	72	89
Unspecified:			
Dimension	23,091	26,328	16,828
Rock for harbor work thousand tons	3,296	NA	NA
Sulfur	585	825	--
MINERAL FUELS AND RELATED MATERIALS			
Carbon dioxide, natural (produced with natural gas) million cubic feet	[e]7,300	NA	NA
Coal:			
Bituminous thousand tons	457	445	389
Subbituminous do	1,819	1,872	1,817
Lignite do	136	170	162
Total do	2,412	2,487	2,368
Coke, gashouse do	30	41	93
Fuel briquets do	--	11	13
Gas, natural:[3]			
Gross production million cubic feet	11,500	32,000	50,000
Marketed production do	11,442	30,945	48,027
Natural gas liquids thousand 42-gallon barrels	34	86	NA
Petroleum:			
Crude[4] do	1,423	3,776	5,391

See footnotes at end of table.

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Table 1.—New Zealand: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS —Continued				
Petroleum —Continued				
Refinery products:				
Gasoline	do	10,402	12,052	10,846
Distillate fuel oil	do	4,219	5,168	4,894
Residual fuel oil	do	6,722	7,795	7,093
Other	do	505	674	780
Refinery fuel and losses	do	1,568	1,704	939
Total	do	23,416	27,393	24,552

[e]Estimated. [p]Preliminary. [r]Revised. NA Not available.
[1]Average 57% iron.
[2]Includes crushed rock for building aggregate, roads, and ballast.
[3]Excludes carbon dioxide component of natural gas, which is reported separately.
[4]Includes crude oil and field condensate.

TRADE

According to the Department of Statistics at Wellington, principal mineral exports during fiscal year 1977 (year ending June 30, 1977) were unwrought aluminum ($116.4 million), iron and steel scrap and iron sand concentrates ($18.1 million), and iron and steel semimanufactures ($13.3 million).

Crude petroleum, partly refined petroleum, and petroleum refinery products dominated New Zealand's mineral imports; they were valued at $528.6 million in fiscal year 1977, or 15% of the total import value. Most of the crude oil was imported from Iran, but Kuwait and Saudi Arabia were also sources of significant supplies. Imports of iron and steel, mainly semimanufactures, totaled $251.5 million. Other significant mineral imports included phosphate rock from Nauru, Australia, and the Gilbert and Ellice Islands, and sulfur from the United States and Canada.

Table 2.—New Zealand: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal including alloys:			
Scrap	1,136	(1)	
Unwrought and semimanufactures	91,248	114,906	Japan 108,281; Hong Kong 4,746;
Copper metal including alloys:			
Scrap	896	446	Australia 290.
Unwrought and semimanufactures	600	1,268	Singapore 639; United States 251; Malaysia 152; Thailand 102.
Iron and steel:			
Ore and concentrate thousand tons	2,293	2,047	All to Japan.
Metal:			
Scrap	2,058	2,254	Japan 1,540; Netherlands 343.
Semimanufactures:			
Bars, rods, angles, shapes, sections	7,137	16,108	Canada 6,630; United States 4,362; Fiji 3,047.
Universals, plates and sheets	28,075	30,077	United States 16,487; Fiji 2,754; Papua New Guinea 1,877; Pakistan 1,725.
Hoop and strip	257	--	
Wire	1,239	5,005	United States 2,202; Canada 1,279; Hong Kong 643.
Tubes, pipes, fittngs	1,963	955	Fiji 337.
Lead metal including alloys:			
Scrap	666	--	
Unwrought and semimanufactures	129	149	Fiji 80.
Platinum group metals and silver, ore and concentrate value thousands	$179	$249	United Kingdom $214.
Zinc metal including alloys:			
Scrap and blue powder	1,012	947	Spain 144.
Other:			
Ash and residue containing nonferrous metals value, thousands	$199	$209	Netherlands $85; Spain $81.

See footnotes at end of table.

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Table 2.—New Zealand: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS			
Cement	5,400	2,296	NA.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s	--	739	NA.
Products:			
Refractory (including nonclay brick) value, thousands	--	$53	NA.
Nonrefractory do	$146	$76	NA.
Fertilizer materials, manufactured:			
Phosphatic	4,654	--	
Other, including mixed	207	194	Australia 151.
Other nonmetals: Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s value, thousands	$201	$1,060	Fiji $681; Australia $166; Samoa $119.
MINERAL FUELS AND RELATED MATERIALS			
Coke and semicoke	5,254	11,244	Republic of Korea 5,715; Japan 5,527.
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	4	--	
Kerosine, white spirit do	202	--	
Distillate fuel oil do	1,089	990	Ship stores 982.
Residual fuel oil do	1,091	1,245	Mainly to ship stores.
Lubricants value, thousands	$369	$508	Fiji $217; Ship stores $188.

NA Not available.
[1]Exports were valued at $1,351 in 1976.

Table 3.—New Zealand: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite and concentrate	546	[1]	
Oxide and hydroxide	235,721	276,021	Australia 271,246.
Metal including alloys:			
Unwrought	1,479	155	Australia 119.
Semimanufactures	4,229	2,096	Australia 595; Japan 401; United States 279.
Arsenic trioxide, pentoxide, acids	1,626	1,458	United Kingdom 1,190.
Chromium oxide and hydroxide	99	177	United States 77; Federal Republic of Germany 51.
Cobalt oxide and hydroxide	8	10	Belgium-Luxembourg 9.
Copper metal including alloys:			
Unwrought	973	1,791	Australia 1,598.
Semimanufactures	[2]11,003	12,774	Australia 10,622.
Iron and steel metal:			
Scrap	27,257	[3]	
Pig iron, ferroalloys, similar materials	6,505	6,786	Australia 3,167; Republic of South Africa 2,285; United Kingdom 559.
Steel, primary forms	r1,728	7,425	Australia 7,399.
Semimanufactures:			
Bars, rods, angles, shapes, sections	77,571	82,998	Japan 37,204; Australia 35,692; United Kingdom 7,870.
Universals, plates and sheets	230,467	370,352	Japan 311,684; Australia 33,233.
Hoop and strip	15,447	17,122	Australia 8,541; Japan 6,493; United Kingdom 1,546.
Rails and accesories	21,720	24,694	United Kingdom 23,094; Japan 1,333.
Wire	17,024	20,106	Australia 8,884; Japan 7,152; United Kingdom 3,508.
Tubes, pipes, fittings	106,458	27,290	Japan 11,525; Australia 5,752; United Kingdom 4,131.
Castings and forgings, rough	257	452	Australia 402.
Lead:			
Oxides	230	287	Australia 273.
Metal including alloys, unwrought	7,722	8,565	Australia 8,488.
Magnesium metal including alloys, unwrought	--	215	United States 150; Japan 60.
Manganese:			
Oxides	997	1,084	Ghana 356; Australia 347; United States 314.

See footnotes at end of table.

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Table 3.—New Zealand: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Nickel metal including alloys:			
Unwrought	109	--	
Semimanufactures	144	332	Canada 124; United States 78; Australia 62.
Platinum-group metals and silver:			
Waste and sweepings value, thousands	$230	$181	Australia $180.
Metals including alloys:			
Platinum-group do	$221	$255	Australia $124.
Silver do	$1,863	$2,181	Australia $2,049.
Tin:			
Oxides	12	7	All from Australia.
Metal including alloys:			
Unwrought	296	315	Australia 311.
Semimanufactures	14	--	
Titanium oxides	1,370	2,527	Australia 1,431; Japan 822.
Tungsten metal including alloys, all forms value, thousands	$275	$269	United Kingdom $213.
Zinc:			
Oxide	82	50	NA
Metal including alloys:			
Unwrought	15,869	21,742	Australia 21,522.
Semimanufactures	348	226	Australia 138.
Other:			
Ores and concentrates of molybdenum, tantalum, titanium, vanadium, zirconium	353	(4)	
Oxides, hydroxides, peroxides of metals, n.e.s	162	280	United States 148.
Metals including alloys, all forms:			
Metalloids value, thousands	$376	$293	France $106; Republic of South Africa $68; Canada $59.
Base metals including alloys, all forms, n.e.s do	$405	$383	Thailand $96; United Kingdom $70; Australia $56; People's Republic of China $51.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	146	142	United States 112.
Grinding and polishing wheels and stones value thousands	$1,356	$1,158	Australia $338; United Kingdom $337; United States $186.
Asbestos	11,965	7,006	Canada 5,610; Republic of South Africa 1,381.
Barite and witherite	9,448	2,045	Australia 1,444; People's Republic of China 501.
Boron materials:			
Crude natural borates value, thousands	$62	--	
Oxide and acid	714	412	United States 409.
Cement	6,468	--	
Chalk	675	757	United Kingdom 433; France 311.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s	7,054	7,888	United States 5,902.
Products:			
Refractory (including nonclay bricks) value, thousands	$4,203	$4,625	United Kingdom $1,801; Australia $1,107.
Nonrefractory do	$659	$605	Japan $272; United Kingdom $214.
Diamond:			
Gem, not set or strung do	$1,862	$1,365	Republic of South Africa $585; United Kingdom $309; Israel $281.
Industrial do	$113	$112	NA.
Diatomite and other infusorial earth	987	642	United States 438.
Feldspar, fluorspar, nepheline syenite	1,040	1,605	Norway 1,158.
Fertilizer materials:			
Crude:			
Nitrogenous	501	--	
Phosphatic thousand tons	1,129	959	Australia 411; Nauru 398; Gilbert and Ellice Islands 149.
Manufactured:			
Nitrogenous value, thousands	$5,165	$6,024	Japan $2,565; Netherlands $1,828.
Phosphatic do	$163	$497	United States $266; Belgium-Luxembourg $123.
Potassic do	$18,187	$19,568	United States $16,837; U.S.S.R. $2,289.
Other, including mixed do	$4,155	$4,659	United States $3,783.
Ammonia	1,190	846	Australia 845.
Gypsum and plasters	159,876	120,612	Australia 120,115.
Magnesite	2,632	2,497	People's Republic of China 2,453.
Mica:			
Crude, including splittings and waste value, thousands	$151	$89	NA.

See footnotes at end of table.

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Table 3.—New Zealand: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Mica —Continued			
Worked, including agglomerated splittings ..do....	$144	$159	United Kingdom $107.
Pigments, mineral:			
Natural, crude	156	312	Austria 254.
Iron oxides, processed	460	880	West Germany 629.
Precious and semiprecious stone, except diamond:			
Natural..... value, thousands..	$1,347	$849	Australia $265; Thailand $183; Federal Republic of Germany $144.
Manufactured.....do....	$52	--	
Salt	53,056	37,720	Netherlands 28,621; United Kingdom 8,006.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	17,646	15,772	United Kingdom 7,984; Australia 5,464.
Caustic potash, sodic and potassic peroxides	289	199	Italy 116.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	2,056	977	Republic of South Africa 475; Brazil 227.
Worked..... value, thousands..	$188	$309	Italy $191.
Quartz and quartzite	594	274	NA.
Sulfur, elemental, other than colloidal	163,693	224,377	Canada 172,803; United States 51,442.
Talc, steatite, soapstone and pyrophyllite	2,756	3,586	Australia 2,564.
Other nonmetals, n.e.s.:			
Crude..... value, thousands..	$153	$78	Federal Republic of Germany $59.
Oxides and hydroxides of magnesium, strontium and barium	289	438	Australia 254; United States 148.
Bromine, iodine, fluorine	15	--	
Building materials of asphalt, asbestos and fiber cement, and unfired nonmetals, n.e.s ..... value, thousands..	$3,584	$160	Australia $105.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	6,956	8,517	Australia 8,090.
Coal and briquets	4,717	845	All from Australia.
Coke and semicoke	2,844	2,618	All from Australia.
Gas, hydrocarbon ..... value, thousands..	$59	--	
Hydrogen and rare gases	739	832	Australia 827.
Peat, including peat briquets and litter	235	220	Norway 58.
Petroleum:			
Crude and partly refined:			
Crude ..... thousand 42-gallon barrels..	16,343	14,188	Iran 9,485; Kuwait 2,956; Saudi Arabia 1,559.
Partly refined .....do....	6,936	6,659	Saudi Arabia 1,554; Australia 1,195; Singapore 1,112.
Refinery products:			
Gasoline .....do....	3,125	3,693	Australia 1,215; Iran 954.
Kerosine and jet fuel .....do....	2,163	2,644	Australia 1,816; Singapore 614; Iran 122.
Distillate fuel oil .....do....	2,615	1,472	Australia 1,315.
Residual fuel oil .....do....	185	355	All from Australia.
Mineral jelly and wax .....do....	35	33	People's Republic of China 14; Japan 8.
Lubricants ..... value, thousands..	$15,439	$15,412	Australia $10,167; United Kingdom $2,783; United States $1,297.
Other:			
Nonlubricating oils, n.e.s ..... thousand 42-gallon barrels..	75	88	United States 34; Australia 33.
Pitch .....do....	54	96	Australia 95.
Bituminous mixtures, n.e.s .....do....	8	5	United Kingdom 3; Australia 2.
Petroleum coke ..... value, thousands..	$4,364	$7,227	All from United States.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals .....do....	$1,301	$1,545	Japan $996; United States $203; Singapore $171.

[r]Revised.
[1]Excludes bauxite valued in thousands at $103 in 1976.
[2]Excludes copper foil, powders, and flakes valued in thousands at $1,433 in 1975.
[3]Excludes scrap valued in thousands at $1,979 in 1976.
[4]Excludes vanadium valued in thousands at $50 in 1976.

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COMMODITY REVIEW

METALS

Aluminum.—The New Zealand Government and New Zealand Aluminum Smelters Ltd. (NZAS) negotiated new rates for electric power supplied to the NZAS smelter at Bluff. The Government contended that existing rates were too low relative to charges to other users of the power grid and decided to extract an oil-equivalent charge. Late in the year, a 30-year agreement was reached that provided for a 4.5 fold rate increase, effective January 1, 1978. This agreement also provided for price escalation every quarter year, based on aluminum prices and the cost of producing electricity, and called for review of the price formula at 3-year intervals.

Gold.—Output was substantially above that of 1976. Kanieri Gold Dredging Ltd., a subsidiary of Amoil New Zealand Ltd. and New Zealand's only gold-dredging operation, produced 6,105 troy ounces of gold from 2,809,845 cubic meters of gravel in the Taramakau River on the west coast of South Island. Operations were centered at Kumaru, between Greymouth and Hokatike. Kanieri experienced operating problems that caused it to consider terminating its operations. Replacements for broken-down equipment were difficult to obtain, labor was in short supply, and operating costs were rising.

Several other companies prospected and explored for gold. Ryan Mining Ltd. produced minor quantities of gold along the Shotover River in the Queenstown area of South Island, following a 3-year evaluation effort. Mineral Resources (New Zealand) Ltd. continued investigation at the former Martha mine at Waihi, North Island. The company worked old stockpiles and mine dumps at Union Hill and tested bulk samples at a recently renovated pilot plant. Blackwater Gold Ltd. and Carpentaria Exploration Co. Pty. Ltd. (Australia) tested ore extensions at a property formerly owned by Blackwater Mines. Amoco Minerals New Zealand Ltd. applied for a prospecting license for the Monowai gold area. There was other gold prospecting in central Otago, but it was small-scale and seasonal.

Iron Sands.—A substantial increase in iron sands output—to nearly 3 million tons—resulted from expansion of production capacity by the country's two producing companies. These companies were New Zealand Steel Mining Ltd., a wholly-owned subsidiary of New Zealand Steel Ltd., and Waipipi Iron Sands Ltd.

New Zealand Steel Mining's $16 million expansion project at Tarahoa was near completion at yearend. A movable concentrator, a second stockpiling facility, new service buildings, a new slurry pipeline, and a new berthing buoy were installed.

Waipipi Iron Sands' new throughput capacity at Waverley of 2,400 to 2,700 tons of crude ore per hour makes possible an annual output of 1.8 million tons of concentrate. The company exported 1,332,000 tons of dry concentrate in 1977, mostly to Japan. Ore reserves as of January 1, 1977, based on an exploratory drilling on a 250-meter grid, totaled 29,446,000 tons of dry concentrate. During the year, Utah International Inc. acquired Marcona Corp.'s 75% interest in Waipipi Iron Sands Ltd.

Steel.—New Zealand Steel Ltd. started an expansion program that is expected to double its concentrate throughput capacity to 250,000 tons per year in 1978 and provide further increases to 750,000 tons per year within 10 years. A new multi-hearth preheating furnace for iron sand concentrate is expected to result in more efficient use of energy and make faster reduction to sponge iron possible, thereby increasing capacity by 30%. Plans also called for a cold-rolling sheet mill and coat line for plain and galvanized sheet. Long-term plans included a new melt shop, continuous-slab casting, and more direct-reduction kilns.

Other Metals.—The Department of Scientific and Industrial Research was investigating black, heavy-metal beach-sand deposits on the west coast of South Island. These sands contain ilmenite, monazite, zircon, and gold.

Small-scale renewed production of copper and zinc ores resulted from a number of prospecting ventures for base metals. Amoco Minerals New Zealand Ltd. applied for prospecting licenses on Coromandel Peninsula and used airborne magnetometry to search for base metals. Otter Minerals Exploration Ltd., in association with Gold Mines of New Zealand Ltd., continued exploration in Nelson Province and was drilling on D'Urville Island. Gold mines of New Zealand Ltd., a partnership of Australian Anglo-American Corp. Ltd., and Amoil New Zealand was also active in the Raukumara, East Cape, and Kaikoura regions.

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NONMETALS

Asbestos.—Asarco Exploration Co. of Canada Ltd. terminated its participation with Kennecott Explorations of Australia Ltd. and Lione and Marble Ltd., New Zealand, in exploration for chrysotile at the Pyke River prospect in northwest Otago, South Island. Tests indicated there are two ore bodies of favorable fiber quality, although further exploration was necessary.

Phosphates.—Cruises in 1976 and 1977 by the New Zealand Oceanographic Institute identified a seabed phosphorite deposit containing 18% to 24% P_2O_5 in nodules and coarse-grained sand. The deposit lies in an east-west belt 16 kilometers wide, along the crest of Chatham Rise, which extends 1,300 kilometers east of Banks Peninsula, South Island. The seabed is 400 to 500 meters deep in the deposit area.

Sulfur.—Fletcher Mining Co. Ltd. attempted to recover sulfur at the 6-million-ton Rotokawa deposit in the Taupo area of North Island. The Frasch process was employed, using hot water from geothermal wells as a heat source, but the attempt was unsuccessful. The company then planned open pit mining to extract molten sulfur using hot water under pressure. Plans were to use a solvent for subsequent sulfur recovery.

Other Nonmetals.—Land Sea Minerals Ltd. was evaluating offshore sand and gravel deposits near Whangarei, North Island. Seasonal and full-time quarrying for construction materials was extensive, particularly in and near cities. Several new rock quarries were opened near Nelson, South Island.

MINERAL FUELS

Coal.—According to the annual report of the Minister of Mines, total coal production was down slightly from that of 1976. Production at State mines was 22% lower than the previous year's production, as a result of reduced deliveries to power stations and the cement industry. Of New Zealand's 70 operating mines, 37 were open pit mines and 33 were underground. The open pit mines accounted for 73% of total output.

The objective of a 5-year Department of Mines coal exploration program was to reclassify inferrred reserves in measured and indicated reserves categories. Exploration started in the eastern part of the Southland lignite field in Mataura Valley, South Island, and was planned to continue in the Waikato area of North Island and the west coast deposits of South Island.

The Department continued development of three major State mines under its $75 million program to increase coal production by 2 million tons per year. The mines are in the Huntly area of North Island and will provide fuel for the Huntly power station and for industrial and residential use. These mines will employ continuous miners and both electric- and hydraulic-powered shuttle cars. Recovery from deep coal seams had been only 40%, but the development program is expected to increase recovery to 70% using improved technology.

The proposed Coal Mines Bill would provide for more Government control of private coal operations through the Minister of Energy, and for Government grant and loan assistance to private exploration and mining proposals. Applicants would be required to submit plans for development programs, including plans for environmental protection and health and safety compliance, and levies would be collected to finance coal research and miners' retirement benefits.

Table 4.—New Zealand: Coal Statistics

(Metric tons unless otherwise specified)

Year	Production		Employment (number of workers)	Exports	Imports
	Open pit	Underground			
1975	1,695,459	716,934	1,600	1,285	4,486
1976	1,764,113	722,791	1,528	10,394	1,345
1977	1,734,297	634,612	1,650	10,605	1,341

Source: State Coal Mine. Mines Statement for Year Ended Dec. 31, 1977.

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Natural Gas.—Production from the Kapuni gasfield was nearly 60% higher than that of 1976, due to newly developed capacity and stepped-up deliveries to the New Plymouth and Stratford power stations. Late in the year, a recalculation of Kapuni reserves resulted in a threefold increase over original estimates.

The first stage of a $1 billion development program conducted by Shell-BP-Todd Oil Services Ltd., operating contractor for the Government, continued at the offshore Maui gasfield, where reserves were estimated at 5.3 trillion cubic feet. Construction of the 12-well Maui-A production platform was delayed by adverse weather and difficult sea conditions. Early in the year, 34-kilometer gas and condensate pipelines to shore facilities were expected in early 1978, and the gas treatment plant at Oaonui was also near completion. A second stage of the development program is planned that includes a Maui-B production platform with associated pipelines and is scheduled for 1983.

The Minister of Energy proposed a new State company that would combine the Government's Natural Gas Corp., which is responsible for natural gas distribution and sales, and the Government's Offshore Mining Co. Ltd. The new company would be responsible for Government participation in onshore and offshore exploration and offshore development.

Petroleum.—Production of condensate at the Kapuni natural gasfield by Shell-BP-Todd, the operating contractor, increased about 43% over the 1977 rate.

There was relatively little exploration activity, pending new Government policy on a proposed petroleum production tax. Government-sponsored exploration began in July; six prospecting licenses were granted in the name of the Minister of Mines. Onshore, two wells were drilled near Aritika, on the west coast of South Island, under a $10 million Government program. The first well was dry and abandoned at 1,500 meters; the second was in progress at yearend.

Offshore, the Seahunt Group drilled two wells from Penrod-74, a semisubmersible rig, in the Great South Basin off the southern coast of South Island. Ownership of the Seahunt Group is shared by the Hunt International Petroleum Co. of New Zealand Ltd. and Phillips Petroleum Ltd. (60% combined ownership) and the New Zealand Government (40%). One well was unsuccessful, but the other encountered traces of natural gas and condensate.

At yearend, 23 onshore and offshore petroleum prospecting licenses were in effect. Less total acreage was licensed for prospecting at yearend 1977 than was licensed at yearend 1976.

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[1]Supervisory physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from New Zealand dollars ($NZ) to U.S. dollars at a rate of $NZ1.00=$US1.03, the exchange rate at yearend 1977.

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The Mineral Industry of Nigeria

By Janice L. W. Jolly[1]

Petroleum revenue formed about 31% of Nigeria's 1977 gross domestic product (GDP) estimated at $31 billion.[2] Nigeria's tin production provided about 1.5% of the world total. Nigeria also produced about 3% of the world's supply of columbium. Cement production was valued at about $40 billion and was being expanded. Nigeria's only operating petroleum refinery at Port Harcourt was furnishing 35% of the country's needs. Frequent oil product scarcities were becoming a regular feature of the Nigerian economy, but the Federal Military Government was hoping to combat this problem with construction of two new petroleum refineries, an extensive product pipeline system, and 18 new storage depots by the early 1980's. To spur renewed interest in lagging petroleum exploration, new petroleum investment incentives were announced in April. Nigeria continued the indigenization of most of the mineral industry. All private industry was subject to the 1977 Nigerian Enterprise Promotion Decree that provided for all ventures to be at least 40% Nigerian.

At yearend, Nigeria was considering limiting oil production and lowering crude oil prices, with a consequent 20% to 40% decrease in revenues expected for 1978. Factors contributing to this decision included the successful moves by industrialized countries in counteracting high oil prices and slower world economic growth and the consequent decline in demand. Many countries had increased petroleum storage capacities and had installed systems using heavy oil, rather than light oil such as that produced by Nigeria. Also, other Organization of Petroleum Exporting Countries (OPEC) members such as Algeria and Libya were selling light crude at lower prices, making Nigeria's product less competitive. Nigerian crude was becoming increasingly more difficult to sell at the high prices asked. The third national development plan, based on revenues from a production of 3 million barrels of crude oil per day, was to be drastically revised.

Electrical shortages were increasingly becoming a problem, hampering industrial growth. The demand for electricity had grown about 25% per year since the first hydroelectric dam became operational at Kainji in 1972. To keep pace with this rapid growth of demand, the National Electric Power Authority (NEPA) was planning new powerplants. New thermal stations were being constructed at Sapele (720 megawatts), and Port Harcourt (720 megawatts), while hydroelectric dams were being built at Shiroro (600 megawatts) and Jebba (545 megawatts). Extensions to the Kainji, Delta, and Afam power stations were also underway. Total installed generating capacity is to be 1,170 megawatts by 1978.[3] Electricity-generating capacity was 46% hydroelectric, 50% gas turbine, and 4% diesel. Energy sales (in megawatts) were divided among industrial consumers 40.5%, residential consumers 31.5%, and commercial consumers 22%. Nigeria also purchases 10 megawatts over a 132-kilovolt line to Niamey.

The Nigerian Government was planning to build a new capital city in the central part of the country. The Federal Capital Development Authority (FCDA) requested the U.S. Geological Survey (USGS) to make a geological and environmental assessment. Geologic, resource, and land-classification maps were being prepared to provide a basis for more detailed engineering studies and final selection of construction sites by the FCDA. The USGS was to coordinate its

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work with the Nigerian Geological Survey and other Nigerian agencies. The USGS maps were to be prepared at a scale of 1:100,000.

PRODUCTION AND TRADE

Crude petroleum production was 765.5 million barrels in 1977, 756.1 million barrels in 1976, and 673.7 million barrels in 1972. Oil revenues had reached a level in 1977 almost nine times that of 1972. Based on an average of $12.90 per barrel for the first quarter and $13.15 for the last three quarters of 1977, an estimated $9.7 billion in oil revenues was earned for the year. Government oil revenues for 1976 were reported as $8.6 billion.[4] This compared with 1.2 billion for 1972. Nigeria exported a total of 740.2 million barrels in 1977, for an average of 2,028,077 barrels per day, representing an increase of 3% over exports in 1976. The United States took 56.4% of Nigeria's total exports during the first 2 months of 1977, and Nigerian crude oil accounted for 19% of U.S. petroleum imports.

Negotiations with U.S. buyers for the sale of liquefied natural gas (LNG), which was to be available by 1980 from the planned new liquefaction plant at Bonny were reaching an advanced stage. Sweden had also expressed an interest in importing Nigerian gas, possibly in exchange for building some of the LNG carriers required.

Tin production showed a further decline, continuing the trend of the past several years. The performance of the tin industry in the first 10 months indicated some improvement, but the final record for 1977 showed a decline from 1976 production. Production averaged 408 tons of tin concentrate for the first 4 months of 1977 but had decreased to an average of 386 tons per month by yearend.

Domestic cement production, which was about 1.3 million tons in 1976, increased to 1.4 million tons in 1977. Although total domestic production was to increase by a further 2 million tons in 1978, current consumption of cement was put at 6 million tons.

Table 1.—Nigeria: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Columbium and tantalum:			
Columbite concentrate, gross weight	990	708	861
Tantalite concentrate, gross weight	1	1	1
Gold, troy ounces	8	[e]10	[e]10
Lead, mine output, metal content[e]	[r]130	[r]130	51
Rare-earth metals: Monazite concentrate[e]	20	20	20
Tin:			
Mine output, cassiterite concentrate:			
Gross weight	6,289	5,050,	4,630
Sn content	4,652	3,710	3,267
Smelter	4,677	3,667	3,315
Tungsten ore and concentrate, gross weight	(1)	(1)	(2)
Zinc ore and concentrate, metal content[e]	745	[r]450	--
NONMETALS			
Cement, hydraulic, thousand tons	[r]1,384	1,274	1,440
Clays, unspecified	131,125	NA	[e]31,100
Feldspar[e]	5,000	5,000	5,000
Stone:			
Limestone, thousand tons	1,631	[e]1,640	[e]1,440
Marble	5,488	[e]4,900	[e]14,500
Shale, thousand tons	197	[e]197	[e]165
MINERAL FUELS AND RELATED MATERIALS			
Coal, do.	240	312	288
Gas, natural:			
Gross, million cubic feet	658,839	764,000	635,661
Marketed, do.	16,094	18,500	[e]15,400
Petroleum:			
Crude, thousand 42-gallon barrels	651,890	756,064	765,473

See footnotes at end of table.

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Table 1.—Nigeria: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS —Continued				
Petroleum —Continued				
Refinery products:				
Gasoline	thousand 42-gallon barrels	4,658	5,270	NA
Kerosine	do.	2,587	1,921	NA
Jet fuel	do.	1,412	1,080	NA
Distillate fuel oil	do.	3,801	5,161	NA
Residual fuel oil	do.	5,695	6,661	NA
Lubricants	do.	469	399	NA
Other:				
Liquefied petroleum gas	do.	115	NA	NA
Unspecified	do.	1,522	220	NA
Refinery fuel and losses	do.	259	479	NA
Total	do.	20,518	21,191	NA

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.
[1]Less than 1/2 unit.
[2]Estimated to be none.

Table 2.—Nigeria: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Columbium and tantalum ores and concentrates	979	1,036	United Kingdom 375; Japan 331; Netherlands 170; United States 130.
Copper matte	--	5	All to West Germany.
Iron and steel metal:			
Scrap	27	336	Belgium-Luxembourg 240; West Germany 60; United Kingdom 36.
Semimanufactures	--	702	All to Netherlands.
Lead ore and concentrate	177	40	All to Belgium-Luxembourg.
Tin:			
Ore and concentrate	250	--	
Metal including alloys, all forms	4,729	3,419	United Kingdom 2,019; Netherlands 1,400.
Uranium ore and concentrate	--	35	All to United Kingdom.
Zinc:			
Ore and concentrate	--	71	Do.
Metal including alloys	46	--	
Zirconium ore and concentrate	--	3	Netherlands 2; United Kingdom 1.
Other nonferrous base metals:			
Ores and concentrates	365	462	Netherlands 437.
Scrap	1,574	1,526	Netherlands 547; United Kingdom 326; West Germany 311; Belgium-Luxembourg 227.
NONMETALS			
Clays	--	(1)	All to United States.
Fertilizer materials, crude	14	11	All to Togo.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	516	545	Brazil 300; Netherlands 110; United Kingdom 59; West Germany 50.
Coal and coke, including briquets	31,024	10,416	All to Ghana.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	605,371	754,098	United States 275,956; Netherlands Antilles 114,508; Netherlands 74,561.
Refinery products:			
Gasoline do.	77	216	United States 136; Equatorial Customs Union [2]54; Niger 19.
Kerosine do.	19	96	Equatorial Customs Union[2] 73; Bénin 21.
Jet fuel do.	110	65	Equatorial Customs Union[2] 51; São Tomé and Principe 7.
Distillate fuel oil do.	443	380	Niger 147; Equatorial Customs Union[2] 134; Ship stores 76.

See footnotes at end of table.

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Table 2.—Nigeria: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum —Continued			
Refinery products —Continued			
Residual fuel oil thousand 42-gallon barrels	2,196	4,329	United States 4,123.
Lubricants do	7	12	Ship stores 9; Equatorial Customs Union[2]; Bénin 1.
Bitumen and bituminous mixtures, n.e.s do	1	148	Netherlands 124; Spain 23.
Total do	2,853	5,246	

[1]Less than 1/2 unit.
[2]Consists of Chad, The Congo, the Central- African Empire, and Gabon.

Table 3.—Nigeria: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum metal including alloys:			
Unwrought	3,298	5,334	Canada 3,004; West Germany 1,194; Norway 786.
Semimanufactures	r16,315	12,127	Switzerland 3,726; United Kingdom 3,102; West Germany 1,555.
Copper metal including alloys:			
Unwrought	4	102	Canada 61; Sweden 19; United Kingdom 10.
Semimanufactures	2,960	4,535	United Kingdom 1,792; West Germany 1,386.
Iron and steel:			
Ore and concentrate, including roasted pyrite	16	1,944	Sweden 1,919.
Metal:			
Scrap	40	491	Ivory Coast 460.
Pig iron, including cast iron	97	31	United Kingdom 16; West Germany 15.
Sponge iron, including powder and shot	714	21	United Kingdom 11; Netherlands 6; France 2; United States 2.
Spiegeleisen	25	71	All from United Kingdom.
Ferroalloys	745	--	
Steel, primary forms	73,519	90,339	West Germany 31,789; United States 10,313; Italy 10,186.
Semimanufactures	1,135,781	1,403,846	Japan 482,542; United Kingdom 278,004; West Germany 261,825.
Lead metal including alloys:			
Unwrought	115	154	United Kingdom 130; Netherlands 19.
Semimanufactures	225	177	United Kingdom 110; West Germany 56.
Nickel metal including alloys:			
Unwrought	10	(1)	All from Czechoslovakia.
Semimanufactures	1190	19	People's Republic of China 11; West Germany 3; United Kingdom 2.
Platinum-group metals and silver:			
Ores and concentrates	42	2	All from France.
Metals including alloys, all forms:			
Platinum-group troy ounces	1,802	1,813	United Kingdom 1,619.
Silver do	351	1,262	United Kingdom 1,092; West Germany 170.
Tin metal including alloys:			
Unwrought	63	978	Zaire 641; Belgium-Luxembourg 225; United Kingdom 112.
Semimanufactures	201,982	347	Hong Kong 260; United Kingdom 86.
Uranium and thorium ores and concentrates	22	--	
Zinc metal including alloys:			
Unwrought	10,116	9,961	Zaire 3,517; Belgium-Luxembourg 2,867; West Germany 1,599.
Semimanufactures	758	172	Finland 69; Zaire 36; West Germany 22; United Kingdom 19.
Other:			
Ores and concentrates of basic metals	280	36	Sweden 28; United Kingdom 7.
Nonferrous metals including alloys, all forms	11,162	9,497	Zaire 5,932; Canada 1,267.

See footnotes at end of table.

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Table 3.—Nigeria: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS			
Abrasives, natural:			
Other	1,768	664	United States 381; United Kingdom 81.
Grinding and polishing wheels and stones	415	1,233	United Kingdom 644; Italy 301; Hong Kong 104.
Asbestos	29,024	55,258	Canada 26,722; West Germany 10,292; Italy 7,373; Switzerland 5,500.
Cement, hydraulic	1,737,542	1,988,219	Spain 355,386; Greece 291,540; Italy 258,855; West Germany 212,565.
Clays and clay products (including all refractory brick)	28,090	27,619	Italy 6,992; West Germany 5,714; United Kingdom 3,839; Spain 2,804.
Diamond, industrial value, thousands	$15	$46	Mainly from India.
Fertilizer materials:			
Crude	26,766	427,791	United States 368,014.
Manufactured:			
Nitrogenous	82,308	90,814	United States 49,161; West Germany 30,551; Netherlands 9,484.
Phosphatic	62,588	99,098	Belgium-Luxembourg 21,025; Netherlands 16,809; West Germany 15,982.
Potassic	r4,604	5,762	West Germany 3,657; Netherlands 2,105.
Other	1,462	12,183	Japan 7,000; West Germany 3,419; Togo 1,250.
Ammonia	2,865	690	United Kingdom 372; West Germany 117; Netherlands 75.
Lime	20,863	17,576	Mainly from United Kingdom.
Mica, all forms	87	106	Italy 86; United Kingdom 11.
Pigments, mineral, including processed iron oxides	4,161	6,762	United Kingdom 4,858; Belgium-Luxembourg 642.
Precious and semiprecious stones, except diamond[3] value, thousands	$1,184	$1,556	Mainly from India.
Salt, excluding brine	199,466	289,859	United Kingdom 170,499; Poland 23,387.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	27,918	24,388	West Germany 11,656; United Kingdom 5,752; United States 3,549.
Caustic potash and sodic and potassic peroxides	6,604	6,751	United Kingdom 3,892; France 1,170; West Germany 777.
Stone, sand and gravel:			
Worked	13,237	1,111	Italy 551; Norway 245; United Kingdom 157; West Germany 105.
Gravel and crushed rock	r19,105	3,646	United Kingdom 1,195; Togo 984; Niger 406; West Germany 396; United States 348.
Sulfur, all types, other than sublimed	543	865	United Kingdom 464; West Germany 388.
Other:			
Crude	7,827	1,145	United Kingdom 611; United States 407.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	117,595	444,620	Italy 264,298; United Kingdom 43,140; Spain 40,069.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	143,208	175,297	Bénin 62,967; Norway 32,069; East Germany 16,900.
Coal and coke, including briquets	8,571	5,352	United Kingdom 4,216; West Germany 1,010.
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	4,317	6,754	Italy 2,148; Netherlands 1,158; United Kingdom 862.
Kerosine do.	675	1,983	Netherlands Antilles 544; France 446; Italy 225; Cameroon 219.
Jet fuel do.	947	679	United Kingdom 133; Netherlands 119; France 102.
Distillate fuel oil do.	1,717	2,637	Netherlands 541; United Kingdom 465; Italy 358.
Residual fuel oil do.	150	60	France 15; Italy 15; Netherlands 9.
Lubricants do.	r393	575	United Kingdom 178; Netherlands 98; United States 67; France 65.
Mineral jelly and wax do.	52	72	Netherlands 25; United Kingdom 18; Italy 15; United States 12.
Bitumen and bituminous mixtures, n.e.s do.	736	4,598	West Germany 1,864; Netherlands 1,137; United Kingdom 904.

See footnotes at end of table.

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Table 3.—Nigeria: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS — Continued			
Petroleum refinery products —Continued			
Other ---------- thousand 42-gallon barrels	23	9	United Kingdom 5; France 1; Netherlands 1; United States 1.
Total ---------- do	r9,010	17,367	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	r77,219	11,249	Netherlands 9,936.

rRevised.
1Less than 1/2 unit.
2Includes pearls.

COMMODITY REVIEW

METALS

Columbium and Tantalum.—Columbite concentrate, recovered in conjunction with tin mining, totaled 861 tons, compared with 708 tons in 1976. Major producers were Bisichi-Jantar Nigeria Ltd. (406 tons), Amalgamated Tin Mines of Nigeria Ltd. (ATMN) (225 tons), and Vectis Tin Mines Ltd. (150 tons).[5] Gold & Base Metal Mines of Nigeria Ltd. produced 8 tons of columbite concentrate in 1977, compared with 9 tons in 1976.[6]

Columbite was separated from other minerals and concentrated by a complex system of size classifiers and magnetic, electrostatic, and airfloat separators at the ATMN concentrating mill located in Jos. The 100-pound bags contained approximately 99% columbite. The price for columbite concentrates varied, with higher tantalum content bringing the higher price. The columbite-to-tantalum content varied between 8:1 and 12:1.

Tantalite was a minor component in the columbite-tantalite concentrates from the alluvial deposits. Tantalum was also produced from the tin slag from the Makeri smelter and was sold abroad for further processing. Tantalum recovered from tin slag was estimated at 50,000 pounds annually. In 1977, approximately 156,000 pounds of tantalum was derived from the columbite concentrate. According to industry sources, total tantalum reserves were estimated at 600 tons of contained recoverable Ta_2O_5 (tantalum pentoxide) in current working sources, or about a 9-year supply. This included about 500 tons of reserves in tin ores.[7]

Iron and Steel.—Steel consumption in Nigeria was expected to reach 3.5 million tons in 1980, and Nigeria was making plans to expand local production. The National Steel Development Authority (NSDA) was planning several direct-reduction steel mills, including mills at Port Harcourt and Warri, and an integrated blast-furnace steelworks at Ajaokuta.

A contract for building the direct-reduction plant at Warri in Bendel State, to be located between Ovian and Aladja, was signed in late 1977 with a six-member West German-Austrian consortium, headed by the West German group Gutehoffnungshütte Sterkrade AG. The plant is to take 3 years to complete and will have an annual capacity of 1 million tons of crude steel. Valued at $700 million, the contract is to include two Midrex direct-reduction furnaces. The iron ore supply for the steel plant is to first be imported from Liberia, the United Kingdom, Sweden, and the Federal Republic of Germany, but would later come from Guinea where Nigeria has a 13.5% share in the Mifergui iron ore project.

At yearend, progress on the Ajaokuta blast furnace project was picking up momentum with assistance from the U.S.S.R. and France. France's Soc. Française d'Etude et d'Installations Siderurgiques (SOFRESID) was commissioned to act as consultant for the planned 2.6-million-ton-per-year steelworks. Development of iron ore at Itakpe and coal at Lafia was also part of the plans. France's Soc. Française d'Etudes Minières (SOFREMINES) was contracted for the iron ore mine engineering.

There were five Japanese joint venture

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steel projects in Nigeria. Galvanizing Industries Ltd., operated by Yodogawa Steel Works, Ltd. and C. Itoh & Co., Ltd. had four galvanizing lines, while Pioneer Metal Products, operated by Nihon Koken Kogyo Co., Ltd., Marubeni Corp., and Hill, had three galvanizing lines. Nigerian Wire Industries was operated by Mitsui & Co., Ltd., and Continental Iron and Steel, which produced 360,000 tons per year of steel bars, was run by Kyoei Steel, Ltd., and Nissho-Iwai Co., Ltd. The fifth company was Standard Industrial Development, which produced small-diameter pipes, operated by Kobe Steel, Ltd., of Mitsubishi Corp. Japanese involvement was increasing, with a new firm, known as Rolled Steel Products Ltd., being set up by Kawasho Corp. (10%), Kenya's Steel Africa Ltd. (50%), and Nigerian concerns (40%). The plant, to be built at Ibadan, is to start up in 1979 and have an initial capacity of 8,000 tons per year of galvanized sheet.

Tin.—In 1977, the principal tin-producing companies on the Jos Plateau were ATMN, Bisichi-Jantar (Bisichi Tin Co. (Nigeria) Ltd. 50% and Jantar Nigeria Ltd. 50%), Exlands Nigeria Ltd., Gold & Base Metal Mines, Kaduna Syndicate, United Tin Areas of Nigeria Ltd., Vectis, Tin and Associated Minerals Ltd. (Kennecott Copper Corp. 49%), and the Government organization Nigerian Mining Corp. (NMC).

Tin concentrate production in 1977 was estimated to be about 4,630 tons of 72.5% tin, down from the 5,050 tons produced in 1976. Production at the Makeri smelter was 3,315 tons of tin metal for 1977, compared with 3,667 tons for 1976. Some improvement in mine production had been evidenced the final quarter of 1976 and early 1977, coinciding with the increase in tin prices on the world market. In general, however, tin production continued to show a decline throughout most of 1977 owing to such factors as irregularities in fuel supplies for earth-moving equipment, mechanical problems, shortages of equipment, and pit wall failure in one of the mining areas. A stagnation in mining investment was also considered to be a major factor in the declining tin production, resulting in a dropoff in exploration as well as production activity, particularly in the deep-seated alluvial ground. A lack of adequately trained staff was also a problem. Tin mining companies were attempting to solve labor-loss problems by improving working conditions. ATMN was also to sell 6% to 10% of its equity to company employees, an action aimed at checking the drift of its workers to the construction industry where wages had risen sharply in recent years.

During the year, the valuation of shares in foreign-owned tin mining companies by the Capital Issues Commission was completed. This set the stage for transfer of majority interests in conformity with the Nigerian Enterprise Promotion Decree enacted in 1977. In 1977, Amalgamated Tin Mines of Nigeria (Holdings) Ltd. of the United Kingdom negotiated the sale of another 20% of its equity in its Nigerian subsidiary ATMN to comply with the new legislation. In August 1976, the British company sold 40% of its shares to NMC, but the 1977 indigenization program requires a minimum Nigerian equity holding of 60% by December 31, 1978. The sale of the additional shares to NMC is to be completed by April 1978, at which time ATMN would become a subsidiary of NMC. By yearend 1977, NMC had also acquired a 21% interest in Makeri Smelting Co. Ltd., a subsidiary of Amalgamated Metal Corp. Ltd. of London, making a total of 40% equity interest held by Nigerians in compliance with Schedule III of the Indigenization Decree. One other major area of investment by NMC was the joint venture with Gold & Base Metal Mines in the Ririwai (Liruen) tin-zinc lode project, in which underground development continued during the year. The revised cost of the project had escalated to $36.5 million.

In 1977, tin reserves were estimated at 60,000 tons (metal content) in the alluvial gravels, according to local sources. Official estimates in past years had put total tin reserves at 280,000 tons (metal content), which constituted about 2.7% of world reserves (including 135,000 tons measured and indicated and 144,200 tons inferred). Undiscovered resources were estimated to be around 590,000 tons.

Bedrock depth in the ATMN active pit in 1977 was 80 feet, but it was 100 feet in the new pit under development. The ore zone, usually occurring near the base of the sedimentary section, was generally about 4 feet wide and contained about 0.75 pound of tin per cubic yard. The tin- and columbite-bearing deposits occur as three types on the Jos Plateau: Alluvial deposits—including present-day deposits along streambeds, laterite and alluvial deposits of the Fluviovolcanic series (a group of sediments and lavas of mid-Tertiary age) that occur beneath the Newer Basalts of late Tertiary

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age, and deep Fluvio-volcanic alluvial deposits; eluvial deposits, which are shallow and generally low grade; and primary vein deposits.

The following tabulation indicates tin production for the first 10 months of 1976 and 1977 as recorded by the major producing companies, in tons of metal content:

Company	January through October	
	1976	1977
Amalgamated Tin Mines of Nigeria Ltd	1,976	1,805
Bisichi-Jantar Nigeria Ltd	346	330
Ex-lands Nigeria Ltd	428	769
Gold & Base Metal Mines of Nigeria Ltd.	280	270
Kaduna Syndicate	200	95
United Tin Areas of Nigeria Ltd	27	21
Vectis Tin Mines Ltd	22	3
Total	3,279	3,293

Source: Standard Chartered Review (London). Nigeria. February 1978, p.46.

NONMETALS

Cement.—In 1977, new cement plants were under construction at Shagamu, Yandev, and Ashaka, and existing plants at Enugu, Ewekoro, Auchi, Calabar, and Sokoto were being expanded. By the end of 1978, Nigeria is to have eight producing cement plants with the following annual capacities: Calabar Cement Co. Ltd. at Calabar, 400,000 tons; Cement Co. of Northern Nigeria at Sokoto, 100,000 tons; Upkilla Cement Co. Ltd. at Auchi, 450,000 tons; Nigerian Cement Co. Ltd. at Enugu, 720,000 tons; West African Portland Cement Co. (WAPCC) at Ewekoro, 705,000 tons, and at Shagamu, 720,000 tons; Ashaka Cement Co. Ltd. at Kano, 300,000 tons; and Benue Cement Co. Ltd. at Yandev, 100,000 tons.

The Shagamu cement plant, a partly owned subsidiary of WAPCC in Ogun State, was built at a cost of $155 million. Two of the six production units were in operation at yearend 1977. When all units are functioning, the plant is to have an annual output of about 1.4 million tons. WAPCC was established in 1959 with Associated Portland Cement Manufacturers Ltd. (APCM) of the United Kingdom as the majority shareholder; in 1977, it held 40% of WAPCC. APCM was exporting bulk cement to Nigeria under a 3-year contract with Nigerian National Supply Co. that began in 1977. About 1 million tons of cement was to be shipped to Lagos during 1978 by APCM.

The following tabulation indicates recent trends in the domestic production, imports, and consumption of cement in tons from 1973 to 1977:[8]

Year	Production	Imports	Consumption
1973	1,241,674	868,766	2,110,440
1974	1,245,739	1,953,960	3,199,699
1975	1,383,504	1,765,982	3,149,486
1976	1,273,504	1,988,219	3,261,723
1977	1,439,793	4,747,388	6,187,181

Source: Standard Chartered Review (London). Nigeria. June 1978, p.39.

Clays.—Kaolin production was estimated at 1,120 tons in 1977. Exploitable clay deposits were discovered in Kaduna and Bendel States by Nigerian Mining Corp. A brick factory was being planned around the deposit in Kaduna.[9]

Salt.—At yearend, the Federal Military Government ordered a massive importation of salt to combat the acute shortage experienced throughout the country. The price for salt had increased about 500%[10] to about $31 per 50-kilogram bag. Licensing for imported salt had been restricted in an effort to protect local salt producers, but this was to be changed to allow 75,000 tons of salt to be imported.

Stone.—*Crushed Rock.*—Cement Roadstone Holdings Ltd., of Ireland, expanded its crushed rock operation in Nigeria with the startup of a 180-ton-per-hour, Finnish-made Lokomo crushing plant and a more modern quarrying operation. The crushing plant processes the hard abrasive granite for use as road metal.[11]

MINERAL FUELS

Coal.-Poland was providing assistance in setting up a Polish-supplied mining laboratory in Nigeria that was to be operational in 1978. Initial output from the Polish longwall mining operations at the Okagbe (Okabba) and Onyeama (Anyeama) coal mines started at yearend. The 18-month Polish contract with National Coal Corp. (NCC) had included mechanization of the mines as well as installation of a coal-crushing and -washing plant that was capable of handling 2,000 tons per day. The Polish company Katowic Arebowa was assisting with underground operations.

Although equipment had already been purchased, a shortage of skilled technical staff was expected to hinder the planned mechanization of the Nigerian coal industry. In addition to local efforts, NCC was

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attempting to fill this need through active overseas recruitment. Qualified Nigerians were reluctant to accept the jobs because of the low salary ratings scheduled by the Government.[12]

Coal reserves were estimated to be about 144 million tons near Enugu, including about 45 million tons at Okabba in Kwara State, 65 million tons at Ogboyoga, and 34 million tons at Orukpa. Lignite reserves of 71 million tons were indicated at Benin. Because of the Enugu coal's higher moisture and ash content (5% to 20%), it was considered a poorer quality fuel. The Enugu coals were being used by Nigerian cement and thermal energy plants.

A $3.3 million plant to remove free shale from coal, as well as to wash and grade the coal, was completed in 1977. NCC was also to build a $47 million plant for large-scale carbonization of the Enugu coal. Products were to include coke char, electrode pitch binder, tar, and creosote.

Coal reserves at Lafia were in excess of 100 million tons, but the coal had a relatively high sulfur and ash content and was to require considerable dressing before coking. The NSDA, with Soviet assistance, was investigating the Lafia coals. The complex rock structure was expected to prove difficult for mining. The Lafia mine was expected to begin producing 50,000 tons per year of coking quality coal by 1979 which would be utilized by the local steel industry.

Natural Gas.—Gas production totaled about 18,000 million cubic meters in 1977; most of this was flared. Gas reserves were estimated to be 1,245 billion cubic meters, or 1.9% of the world total.

Decisions were being firmed up on the building of an LNG plant at Bonny, the main oil export terminal. Shell Oil Co. and British Petroleum Co. Ltd. (BP) were to each have 10% interest in the project; Phillips Petroleum Co., A.S.p.A., and Essence et Lubrificants de France (ELF) were to each have 5%; and Nigerian National Petroleum Corp. was to have the remainder. The project cost was estimated at nearly $5 million. Constructing one large plant at Bonny instead of the two smaller ones planned earlier was expected to result in considerable savings. Shell-BP had signed an agreement with the Government in 1976 for the construction of an 800-million-cubic-foot-per-day plant. Phillips-Agip-ELF were also working on the feasibility study for a second plant to be located at Escravos. Plans for both of these plants were apparently discontinued in favor of the one larger plant at Bonny.

The Bonny LNG plant was to have a rated capacity of 1,600 million cubic feet per day, which amounts to 16,500 million cubic meters per year or roughly 90% of Nigeria's current associated gas production. Initial gas input to the plant was to be 300 million to 600 million cubic feet per day. The gas-gathering network needed to service the plant was to be the responsibility of the Government, which would take between 85% and 100% participation in this part of the project. In addition, the State planned to take a 50% holding in shipping facilities.[13]

The firming up of plans for the LNG plant was also a significant move forward for the planned petrochemical complex at Port Harcourt that has been under discussion for some years and was to draw its feedstock from the LNG project. Bids for the managing contractorship of this project, which was to be based on a 250,000-ton-per-year ethylene plant, were under evaluation. Contenders included Bechtel Corp., Foster Wheeler Corp., and Ralph M. Parsons Co. of the United States.

Petroleum.—*Production.*—Nigeria was producing an average of 2.2 million barrels of crude oil per day in the first 6 months of 1977, but by December, this had decreased to 1.9 million barrels per day. Exports had also declined to about 1.9 million barrels per day by yearend. By March, storage tanks were completely full, and the oilfields feeding the storage tanks were forced to shut down intermittently throughout the rest of the year. Production shutdowns, caused in part by Nigerian overpricing, were largely negating any cashflow benefits that may have been derived from the newly announced incentives.

Nigeria was a price hawk among the light, low-sulfur crude oil producers. Nigerian crude oil was about 70 cents higher than Libyan oil in 1977. Most of the price increase went into Government coffers; the profit margins of the companies did not improve. By yearend, however, Africa's three leading oil producers were all reducing the quality premium differentials on their overpriced crude by 20 to 30 cents per barrel. Because their oils were high quality, low sulfur, and close to European and U.S. markets, Algeria, Libya, and Nigeria had charged premiums of up to $2 per barrel. Nigeria's Bonny Light crude was officially priced at $14.63 per barrel. The oil industry

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considered Nigeria's crude to be overpriced in light of a softer market.

A decree issued April 29 dissolved the Federal Ministry of Petroleum Resources and Nigerian National Oil Co. (NNOC). A new organization called Nigerian National Petroleum Corp. (NNPC) was established to replace them. The Government, through NNPC, had a 55% share in each of the major producers in Nigeria, with NNPC acting in the dual role of a State company and the Government regulating body for the industry. Although the Government adopted its 55% share in the operations and production of most companies in 1974, compensation arrangements are not expected to be completed until 1978.

Texaco Overseas (Nigeria) Petroleum Co. and Chevron Oil Co. received about $71.6 million from NNPC for a 55% share in oil exploration and production operations of the two companies in Nigeria. Texaco Inc. was to continue as operator for the three producing fields and several prospecting leases. The settlement was backdated to May 1, 1975. Texaco and Chevron each held 22.5% of the new company.

Nigeria's major crude oil producers are shown in Table 4.

Table 4.—Nigeria: Major crude oil producers in 1977

Company	Ownership	Production (barrels per day)
Shell-BP Petroleum Development Co. of Nigeria Ltd.	Royal Dutch/Shell Group (Netherlands) 22.5%, British Petroleum Co. Ltd. (United Kingdom) 22.5%, Nigerian National Petroleum Corp. (NNPC) 55%.	1,200,000
Elf Nigeria	Elf Aquitaine (France) 45% and NNPC 55%	79,446
Gulf Oil Co. (Nigeria) Ltd	Gulf Oil Corp. (United States) 45% and NNPC 55%	290,623
Mobil Producing Nigeria	Mobil Oil Corp. (United States) 45% and NNPC 55%	223,394
Nigerian AGIP Oil Co. Ltd	Agip S.p.A. (Italy) 22.5%, Phillips Oil Co. (Nigeria) Ltd. 22.5%, NNPC 55%.	213,347
Ashland Oil (Nigeria) Co	NNPC 100%	6,368
Pan Ocean (Nigeria) Oil Corp	Marathon Oil Co. (United States) 100%	9,819
Texaco Overseas (Nigeria) Petroleum Co	Texaco Nigeria Ltd. 22.5%, Chevron Oil Co. (United States) 22.5%, NNPC 55%.	53,144

NNPC's long-term crude oil sales contracts with foreign producers expired at yearend. Draft sales agreements with NNPC were expected to be in operation throughout much of 1978.

The Federal Military Government was to purchase a new tanker that would join the 270,000-ton *Oleibiri* bought in 1976. The new tanker was to be about 100,000 tons and would be used for the Nigeria-to-United States route.

According to NNPC, through efficient production practices and effective conservation controls, Nigeria's petroleum production could exceed the current calculated lifespan of 25 years. Unofficial estimates put the country's oil reserves at more than 20 billion barrels, which accounted for 3% of world reserves.[14]

Exploration.—To reverse the 3-year trend of low exploration activity, an investment incentives package was announced April 1, effective immediately. The new investment law contained changes in exploration cost deductions, petroleum profits tax and royalty rates, annual capital allowances, and company investment tax credits.

To encourage early definition of petroleum discoveries, all exploration drilling costs, as well as costs for the first two appraisal wells, successful or not, were allowed to be written off as an expense against tax. Previously, all dry well costs were expensible, but cost items for successful wells were regarded as capital.

To provide some relief for new investors from the petroleum tax requirements, the profits tax rate was to be temporarily reduced to the lowest level operating for any OPEC member. The reduced tax rate (65.75%) was to apply only for the period of amortization of preproduction costs, after which the company would be required to pay the normal 85% profits tax. This incentive was designed to attract new investors and would not apply to already established producers. Companies such as Japan Petroleum Exploration Co., Ltd. which had five offshore prospecting concessions and has drilled few successful wells, would be eligible.

The royalty rate was to be graduated, taking into account the environment of the operations. For onshore production, the roy-

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alty would be 20%; for offshore production in areas up to and including 100 meters deep, the royalty would be 18.5%; and for offshore production in areas over 100 meters deep, the royalty would be 16.7%.

Petroleum companies were to be allowed to amortize assets in five equal annual installments to recover investment outlays. Even so, 1% of the initial costs of each asset was to be retained, and could be written off only by official permission of the Commissioner of Petroleum.

A capital investment tax credit was also approved for existing oil companies. This tax credit was to vary according to individual situations. Thus, operations onshore were to have a tax credit of 5%, offshore areas up to and including 100 meters deep 15%, and offshore areas over 100 meters deep 20%. This move was to encourage and reward existing petroleum companies for new investment.

Following announcement of the new petroleum incentives, drilling activity had picked up by mid-1977 from the depressed levels of 1976, and 18 rigs were in operation at that point. By yearend, however, the number of rigs employed had dropped again to 14.

Nigeria was not expected to have a policy for deepwater petroleum development areas until the end of 1978 or early 1979. Terms and arrangements were expected to be somewhat different from those for exploration within the 200-meter boundary.

NNPC began oil exploration in the Lake Chad basin. Exploration by Nigerian AGIP Oil Co. Ltd. had resulted in the discovery of new oil deposits in the Niger Delta, where other Nigeria AGIP producing wells were located. One new well, the Clough Creek I, was producing 1,000 tons of high-grade petroleum per day.

Refining.—The existing refinery called Alesa Eleme located near Port Harcourt, owned 60% by NNPC and 20% each by Shell and BP, was inadequate for Nigeria's needs, resulting in increasing imports of oil products and frequent shortages. The plant's annual capacity of 60,000 barrels per day was being expanded to 75,000 barrels per day. Nigeria was also establishing two new refineries, one at Warri and one at Kaduna.

The refinery at Warri, with a capacity of 100,000 barrels per day, was under construction and is expected to be operating in 1978. The Italian firm SNAM Progetti S.p.A., part of the Ente Nazionale Idro Carburi (ENI) Group, was building this refinery, expected to cost around $630 million. Contracts were signed during 1977 for the Japanese firm Chiyoda Chemical Engineering & Construction Co., Ltd., to build the third refinery at Kaduna. The Kaduna refinery is expected to have a capacity of 100,000 barrels per day and cost about $660 million. A 35,000-barrel-per-day lubricating oil plant was also to be included. Both are scheduled to come onstream in 1980.

Nigeria's petroleum product distribution system is to include 18 storage depots and 3,000 kilometers of pipeline. Pipelines to service the new refineries were being built by Williams International Co. of the United States, Montaggi Materiali Tubolari S.p.A. (Montubi) of Italy, Tsvetmetpromesport of the U.S.S.R., and Iranian Management & Engineering Group Ltd. (IMEG). Williams International is expected to finish its part of the pipeline from Port Harcourt to Makurdi by September 1978, but the Iranian-Soviet section from Kaduna to Port Harcourt is not expected to be finished until 1980. Halcor International of Houston was subcontracted by Montubi to lay 1,100 kilometers of the 1,700 kilometers awarded to Montubi, stretching from Kaduna to Zaria, Kano, Gusau, Jos, Gombe, and Maidurguri. Bids were let for the pipeline that was to extend from Sapele to Ajaokuta to feed the steel mill under construction there. Contracts worth $250 million were awarded to French and Swedish firms for design and construction of petroleum storage depots. When completed, the storage program would provide a 1,342,000-ton capacity, which would be sufficient for up to 90 days' consumption, compared with the present storage capacity of 162,814 tons. These facilities were to be completed by November 1978.

The Federal Military Government acquired 100% interest in Esso Standard Nigeria Ltd., an oil-product marketing company. The name of the company was changed to Unipetrol (Nigeria) Ltd., and it was to be expanded to serve as a vehicle for distribution of refined petroleum products throughout the country.

Uranium.—Nigeria was reportedly investing $1.5 million in a joint venture with the Government of Niger for the purpose of uranium exploration.[15] BRGM Nigeria Ltd., a subsidiary of the French Bureau de Recherches Géologiques et Minières (BRGM),

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discovered indications of uranium in Nigeria and was continuing its exploration program.

[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Nigerian naria (N) to U.S. dollars at the rate of N1.00=US$1.46.

[3]Standard Chartered Review (London). West Africa, Nigeria. December 1977, p. 35.

[4]U.S. Embassy, Lagos, Nigeria. State Department Telegram 02005, Feb. 16, 1978.

[5]Mining Annual Review (London). Columbium-Tantalum. June, 1978, p. 88.

[6]The Financial Times (London). Mining Briefs. Jan. 26, 1978, p. 26.

[7]Tantalum Producers International Study Center (TIC) (Brussels). World Tantalite/Columbite Reserves. Quarterly Bull. 15, September 1978, pp. 2-3.

[8]Data may differ from that reported elsewhere in this chapter owing to a difference in source.

[9]Industries et Travaux d'Outreme (Paris). Afrique de l'Ouest. No. 289, December 1977, p. 831.

[10]Rock Products. From Ireland to Nigeria. V. 81, No. 2, February 1978, pp. 60D-60E.

[11]New Nigerian (Kaduna). Government Acts to End Salt Shortage in Country. Jan. 31, 1978, pp. 1-3.

[12]New Nigerian (Kaduna). Manpower Shortage May Hinder Coal Mechanization. Oct. 5, 1977, p. 9.

[13]Petroleum Economist (Nigeria). Gas Export Plans Revised. V.45, No. 1, January 1978, p. 27.

[14]New Nigerian (Kaduna). Long-Term Oil Prospects. July 28, 1978, p. 17.

[15]Industries et Travaux d'Outremer (Paris). Nigeria. No. 290, January 1978, p. 32.

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The Mineral Industry of Norway

Joseph B. Huvos[1]

In 1977, Norway—which, thanks to sizable hydroelectric resources, is a major producer of aluminum, magnesium, and ferroalloys—was on its way to becoming a major oil producer. It was also a major ilmenite producer.

The Norwegian mineral industry suffered from the poor performance of the economy as a whole. Rapidly increasing unit wage costs and weak foreign demand eroded Norway's export markets, and the balance of trade reached a deficit of about $5.2 billion.[2] Unemployment was maintained at less than 1% of the work force through subsidies.

In 1977, Norway's gross national product (GNP) was about $34 billion.[3] The contribution of the mineral industry to employment did not change significantly in 1977, remaining at about 11% of the total of about 415,000 (mining, 10,000; mining products, 15,000; and metals, 21,000).

Important developments in Norway's mineral industry in 1977 were the start of natural gas deliveries from the North Sea to Emden, Federal Republic of Germany; stagnation of North Sea oil production because of a blowout; commissioning of a new magnesium chloride plant by Norsk Hydro A/S; commissioning of an extension of A/S AArdal og Sunndal Verk's (ASV) AArdal aluminum smelter; and discoveries of iron and phosphate ores in mainland Norway and of coal, uranium, and offshore oil in the Svalbard Islands. Government measures included formation of an Oil and Energy Ministry; formal establishment of a price support fund for copper; and authorization for Elkem-Spigerverket A/S to build an additional electric arc furnace for ferrosilicon.

PRODUCTION

In 1977, total production in mining, industry, and power increased about 10% over that of 1976, but there was a slight decrease in crude oil production. Production of mineral commodities is shown in table 1. The following tabulation shows the major producers of mineral commodities:

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Commodity	Major producers	Principal facilities	Principal ownership	Percent of output
Aluminum	A/S AArdal og Sunndal Verk	Smelters at AArdal, Sunndalsora, Hoyanger.	Government 75% and Alcan Aluminium Ltd. (Canada) 25%.	45
	Mosal Aluminium A/S	Smelters at Mosjoen and Lista Island	Elkem-Spigerverket A/S 50% and Aluminum Co. of America (Alcoa) 50%.	25
	Norsk Hydro A/S	Smelter on Karmoy Island	Government 51%	17
	Sor-Norge Aluminium A/S	Smelter at Husnes	Alusuisse 75% and Norsk Hydro A/S 10%	10
Coal	Store Norske Spitsbergen Kulkompani A/S.	Mines at Longyearbyen and Svea	Government	100
Copper ore	Sulitjelma Gruber A/S	Mine at Fauske	Elkem-Spigerverket A/S	15
	Folldal Verk A/S	Mines at Dovre and Kvalsund	Borregaard A/S	14
	Grong Gruber A/S	Mine at Royrvik	A/S AArdal og Sunndal Verk	14
Copper, refined	Sulitjelma Gruber A/S	Smelter at Sulitjelma	Elkem-Spigerverket A/S	100
Ferroalloys	Elkem-Spigerverket A/S	Plants at Svelgen, Kristiansand, Porsgrunn, Salten.	Self-owned	30
	Electric Furnace Products Co. Ltd	Plant at Sauda	Union Carbide Corp. (United States)	36
	Tinfos Järnverk A/S	Plants at Notodden and Kvinesdal	Self-owned	25
Ilmenite	Titania A/S	Mine at Telnes	N.L. Industries, Inc. (United States)	99
Iron ore	A/S Sydvaranger	Mine at Sor-Varanger	Government	61
	A/S Rana Gruber	Mine at Rana	A/S Norsk Jernverk and Government	33
	Fosdalens Bergverks A/S	Mine at Verran	Self-owned	3
Iron and steel	A/S Norsk Jernverk	Plant at Mo i Rana	Government 51%	80
Lead and zinc ore	A/S Bleikvassli Gruber	Mine at Hemnes	Fangel & Co. A/S	13
	Folldal Verk A/S	Mine at Dovre	Self-owned	12
	Bergverksselskapet, Nord-Norge A/S	Mine at Rana	Self-owned	12
Magnesium	Norsk Hydro A/S	Smelter at Heroya near Porsgrunn	Government 51%	100
Nickel and cobalt	Falconbridge Nikkelverk A/S	Smelter at Kristiansand	Falconbridge Nickel Mines Ltd. (Canada)	100
Petroleum, crude	Phillips Norway Group	Field at Ekofisk (North Sea)	Phillips Petroleum Co. (Norway) 40%	100
Petroleum products	A/S Norske Esso	Refineries at Slagen and Valloy	Standard Oil Co. (New Jersey) (United States)	44
	Rafinor A/S & Co	Refinery at Mongstad	Norsk Hydro A/S 30% and Government 70%	32
	A/S Norske Shell	Refineries at Sola and Valloy	Bataafse International Petroleum Maatschappij N.V. (Netherlands).	23
Pyrites	Folldal Verk A/S	Mine at Dovre	Borregaard A/S Sarpsborg	43
	Elkem-Spigerverket A/S	Mine at Skorovas Gruber (near Namsskogan).	Self-owned	25
	Sulitjelma Gruber A/S	Mine at Fauske	Forsikrings A/S and Royal Insurance Co. Ltd. (United Kingdom).	20
Zinc, electrolytic	Det Norske Zinkkompani A/S	Smelter at Odda	Boliden AB (Sweden)	100

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Table 1.—Norway: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Aluminum metal:			
Primary ingot	594,828	617,579	628,285
Secondary ingot	10,335	14,915	[e]15,000
Super pure	4,700	4,700	4,700
Cadmium, smelter	47	80	97
Cobalt metal	773	576	705
Copper:			
Mine output, metal content:			
In copper concentrate	26,647	31,080	29,501
In cupriferous pyrite	1,468	--	--
Total	28,115	31,080	29,501
Metal:			
Primary:			
Blister	26,349	23,393	26,586
Refined	19,675	17,757	19,976
Secondary	5,687	6,217	NA
Iron and steel:			
Iron ore and concentrate thousand tons	4,109	3,972	5,724
Roasted pyrite do	136	155	[e]160
Metal:			
Pig iron do	638	656	549
Ferroalloys:			
Ferrochrome do	27	31	23
Ferromanganese do	339	349	250
Ferrosilicon (75% basis) do	295	278	236
Ferrosilicomanganese do	163	168	137
Other do	31	31	18
Total do	855	857	664
Steel, crude do	907	909	733
Semimanufactures:			
Rolled do	673	666	500
Finished castings do	19	14	10
Lead, mine output, metal content	3,229	3,861	3,300
Magnesium metal, primary	38,337	38,808	38,165
Nickel:			
Concentrate, metal content	304	525	[e]525
Metal, primary	37,056	32,685	38,223
Platinum-group metals[1] troy ounces	46,779	48,676	NA
Silicon, elemental[1]	49,748	55,993	49,982
Titanium:			
Ilmenite concentrate	526,666	766,664	828,359
Dioxide[e]	23,000	25,000	NA
Vanadium, mine output, metal content[e]	460	530	600
Zinc:			
Mine output, metal content	24,004	29,317	30,323
Metal, primary	60,891	64,352	69,384
NONMETALS			
Cement thousand tons	2,716	2,686	2,333
Feldspar, lump[3]	44,957	37,690	[e]40,000
Fertilizer materials:			
Manufactured:			
Nitrogenous:			
Gross weight thousand tons	993	928	NA
Elemental N content (total) do	495	473	505
Potassic do	[r]4	4	NA
Compound and other do	1,187	1,084	NA
Ammonia do	764	522	NA
Graphite	8,925	9,071	9,037
Lime, hydrated and quicklime	120,576	90,243	[e]100,000
Mica[1]	3,577	3,083	2,818
Olivine sand	309,233	529,291	[e]500,000
Pyrite and pyrrhotite, gross weight	475,112	367,588	308,663
Sodium and potassium compounds, n.e.s.:			
Caustic soda	72,873	74,605	73,885
Sodium carbonate	19,208	13,715	22,000
Stone:			
Dimension:			
Syenite (labrador)	[e]60,000	NA	NA
Slate	65,202	51,535	NA
Crushed and broken:			
Dolomite:			
Ground	58,704	NA	NA
Not further described	463,761	467,346	NA
Limestone thousand tons	5,337	5,410	NA
Nepheline syenite	200,853	216,607	210,912
Quartz and quartzite	824,081	724,029	NA
Other[3] thousand tons	1,100	1,106	NA

See footnotes at end of table.

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Table 1.—Norway: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
NONMETALS —Continued			
Sulfur: Sulfuric acid (100%)	327,911	404,566	387,798
Talc, soapstone, steatite:			
Unground	46,978	50,639	NA
Other	58,015	67,572	NA
Total	104,993	118,211	[e]120,000
Other: Oxides and hydroxides of magnesium, strontium, barium	19,715	27,085	NA
MINERAL FUELS AND RELATED MATERIALS			
Coal, all grades thousand tons	422	525	455
Coke, all grades do	265	283	317
Gas, manufactured million cubic feet	879	895	729
Peat:			
For agricultural use [e]	60,000	60,000	60,000
For fuel use[e]	1,200	1,100	1,100
Petroleum:			
Crude thousand 42-gallon barrels	68,900	101,900	101,887
Refinery products:			
Motor gasoline do	7,702	8,915	--
Kerosine do	1,056	1,299	--
Jet fuel do	1,703	1,715	--
Distillate fuel oil do	19,862	25,566	--
Residual fuel oil do	17,306	17,534	--
Lubricants do	58	59	--
Other do	5,254	5,525	--
Refinery fuel and losses do	3,290	2,923	--
Total do	56,231	63,536	--

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]Exports.

[2]Excludes nepheline syenite.

[3]Excludes a quantity of stone only reported volumetrically in cubic meters, as follows: 1975—5,309,437; 1976—4,774,485; and 1977—NA.

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TRADE

Norway's trade deficit in 1977 increased to $5.2 billion, caused both by the high level of domestic demand, including investment in North Sea oil equipment, and by reduced competitiveness of domestic goods in domestic markets.

Nonferrous metals (aluminum, magnesium, and nickel), ferroalloys, rolled steel, and liquid fuels were the country's main export items. Liquid fuels, iron and steel, alumina, and nickel matte were the main import items. Norway's mineral commodity trade in 1976 and 1977 is shown in tables 2 and 3.

Table 2.—Norway: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Alumina	2	3	NA.
Metal including alloys:			
Scrap	r8,524	10,148	West Germany 5,816; Sweden 1,341.
Unwrought	451,500	561,791	West Germany 168,497; United Kingdom 115,632; Netherlands 50,970.
Semimanufactures	37,143	50,271	United Kingdom 16,098; Sweden 10,769; Denmark 6,328.
Cadmium	61	93	NA.
Cobalt	601	936	NA.
Copper:			
Ore and concentrate	83,270	105,715	West Germany 79,728; Sweden 19,648.
Oxide and hydroxide	2,154	3,000	Taiwan 20; Poland 18; Nigeria 15; Czechoslovakia 10.
Metal including alloys:			
Scrap	r1,362	2,303	West Germany 1,408; Belgium-Luxembourg 454.
Unwrought:			
Unrefined	6,969	5,865	All to West Germany.
Refined	18,363	16,111	United Kingdom 4,620; Sweden 3,711; West Germany 2,607; France 2,292; Netherlands 1,653.
Semimanufactures	1,837	1,978	Sweden 1,153; West Germany 285; Denmark 248; United Kingdom 192.
Gold metal, unworked or partly worked troy ounces	2,025	6,687	West Germany 1,575; Denmark 997; France 868.
Iron and steel:			
Ore and concentrate, except roasted pyrite thousand tons	3,154	2,729	United Kingdom 1,109; West Germany 987; Poland 250.
Roasted pyrite	113,194	137,842	West Germany 109,167; Denmark 23,337.
Metal:			
Scrap	r19,515	17,826	West Germany 7,025; Spain 6,817; Sweden 3,406.
Pig iron, including cast iron	100,863	96,613	United Kingdom 36,110; West Germany 21,673; Poland 11,350.
Ferroalloys:			
Ferromanganese	256,639	327,222	West Germany 61,417; United Kingdom 44,366; Sweden 41,000.
Other	385,969	446,327	West Germany 117,327; United Kingdom 108,691; United States-Puerto Rico 58,988.
Steel, primary forms	r185,297	207,107	Netherlands 154,759; West Germany 21,169.
Semimanufactures:			
Bars, rods, angles, shapes, sections	217,809	189,963	United Kingdom 42,695; Sweden 39,152; Denmark 27,744; West Germany 25,882.
Universals, plates, sheets	129,073	163,104	Sweden 59,784; United Kingdom 39,712; Denmark 26,985.
Hoop and strip	13,422	22,924	Sweden 14,515; United Kingdom 3,075; Denmark 2,467.
Rails and accessories	r249	--	
Wire	4,772	6,785	United Kingdom 1,751; Portugal 1,311; Iran 1,111.
Tubes, pipes, fittings	r36,495	37,744	Sweden 17,188; Denmark 8,751; United Kingdom 5,728.
Castings and forgings, rough	r12,823	7,347	Sweden 5,401; Liberia 1,165.
Total	r414,643	427,867	
Lead:			
Ore and concentrate	4,100	4,599	West Germany 2,389; Netherlands 2,210.
Oxide	14	32	United Arab Emirates 18; Thailand 13.
Metal including alloys:			
Scrap	4,744	7,017	Denmark 3,811; Sweden 3,189.

See footnotes at end of table.

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Table 2.—Norway: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Lead —Continued			
Metal including alloys —Continued			
Unwrought	575	448	Sweden 210; West Germany 165; Greece 44.
Semimanufactures	6	121	Sweden 80; Yugoslavia 36.
Magnesium metal including alloys:			
Unwrought ____ value, thousands	$40,805	$74,951	Netherlands $10.
Wrought	241	87	Netherlands 71; Belgium-Luxembourg 12.
Manganese ore and concentrate	2,730	420	United Kingdom 350; Belgium-Luxembourg 70.
Nickel:			
Ore and concentrate	6,885	12,522	All to Finland.
Metal including alloys:			
Scrap	354	394	West Germany 345.
Unwrought	29,489	34,071	United States-Puerto Rico 13,845; West Germany 6,508; Netherlands 3,992; Canada 3,492.
Semimanufactures	26	4	NA.
Platinum-group metals and silver:			
Waste and sweepings ____ kilograms	48,652	35,197	West Germany 29,957.
Metals including alloys:			
Platinum-group ____ troy ounces	46,779	48,676	United States 21,348; West Germany 11,639; Netherlands 10,095.
Silver ____ do	959,795	1,071,904	Sweden 904,946; Denmark 95,455.
Rare-earth metals: Oxides	10	17	United States 14; Japan 1; United Kingdom 1.
Silicon, elemental	49,748	55,993	U.S.S.R. 18,437; West Germany 14,072; United Kingdom 10,003.
Tin metal including alloys:			
Scrap	21	54	United Kingdom 19; West Germany 18; Denmark 17.
Unwrought	42	65	Finland 23; Denmark 18; Sweden 18; United Kingdom 6.
Semimanufactures	9	7	West Germany 5; Finland 1; Sweden 1.
Titanium:			
Ore and concentrate (ilmenite)	534,606	728,346	NA.
Oxide	962	1,102	Sweden 621; United Kingdom 315; Denmark 150.
Tungsten metal including alloys, all forms value	$4,000	$55,000	United Kingdom $50,000.
Uranium and thorium metals including alloys, all forms ____ do	r$16,000	--	
Zinc:			
Ore and concentrate	14,765	18,898	Poland 11,345; Belgium- Luxembourg 6,083.
Oxide	344	555	Denmark 262; Sweden 225.
Metal including alloys:			
Scrap	114	347	Sweden 117; West Germany 87; United Kingdom 84; Denmark 49.
Blue powder	2,838	2,850	NA.
Unwrought	41,838	58,326	Sweden 20,860; United Kingdom 14,405; West Germany 10,697.
Semimanufactures	388	3,229	Sweden 749; Romania 590; Poland 535; West Germany 423.
Other:			
Ash and residue containing nonferrous metals	47,149	56,459	West Germany 28,903; United Kingdom 12,694; Denmark 9,049.
Oxides, hydroxides, peroxides of metals	1	--	
Metals including alloys:			
Metalloids, n.e.s.	22	10	Belgium-Luxembourg 4; United States 3; Netherlands 2; Canada 1.
Pyrophoric alloys value, thousands	$9	$1	NA.
NONMETALS			
Abrasives, natural, n.e.s.: Grinding and polishing wheels and stones	r527	701	Poland 178; Sweden 174; Finland 75.
Asbestos	5	28	France 18.
Barite and witherite	2,979	13,913	United Kingdom 11,750; United States 1,300.
Cement, hydraulic ____ thousand tons	981	891	Ghana 603; United States 184; Liberia 92.
Chalk	47	4	NA.
Clays and clay products (including all refractory brick):			
Crude	160	NA	
Products:			
Refractory (including nonclay brick)	r6,582	4,684	West Germany 2,104; Sweden 1,318.
Nonrefractory ____ thousand tons	3,956	3,874	West Germany 2,675; France 1,121.
Diamond, gem, not set or strung value, thousands	$8	$20	West Germany $18.
Diatomite and other infusorial earth	16	83	Denmark 41; Sweden 36.

See footnotes at end of table.

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Table 2.—Norway: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Feldspar and related materials	300,773	304,133	Netherlands 72,608; West Germany 67,601; United Kingdom 56,435; France 28,958.
Fertilizer materials:			
Manufactured:			
Nitrogenous value, thousands	$84,869	$61,675	NA.
Phosphatic	3	2	NA.
Potassic	2	446	United Kingdom 426.
Other value, thousands	$101,456	$77,476	NA.
Ammonia do	$12,599	$9,633	NA.
Graphite, natural	8,395	9,019	NA.
Gypsum and plaster	20,378	17,014	Ghana 15,002; Liberia 2,012.
Lime	100	119	NA.
Mica, crude, including splittings and waste	3,577	3,083	West Germany 944; Portugal 336; Netherlands 322.
Pigments, mineral: Processed iron oxides	61	90	Sweden 55; United Arab Emirates 18; Thailand 16.
Precious and semiprecious stones, except diamond value, thousands	$5	$15	Denmark $12.
Pyrite, gross weight	231,251	140,290	Sweden 98,934; West Germany 21,150; France 17,683.
Salt	2,732	2,613	Sweden 1,223; Faroe Islands 580; Iceland 448; Canada 252.
Sodium and potassium compounds, n.e.s. value, thousands	$335	$456	NA.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Marble and other calcareous	1,589	2,819	West Germany 1,430; Italy 526; Japan 380.
Slate	44,018	45,911	Netherlands 22,219; West Germany 8,449; Denmark 6,420; Belgium-Luxembourg 4,869.
Other[r]	90,252	94,364	France 28,022; Italy 26,443; West Germany 21,038; Spain 8,265.
Worked, all types	308	195	Mainly to Sweden.
Dolomite	81,213	116,197	NA.
Gravel and crushed rock thousand tons	1,129	1,194	West Germany 689; United Kingdom 238; Denmark 118.
Limestone, except dimension	140,174	81,994	West Germany 46,407; Denmark 30,216.
Quartz and quartzite	3,641	4,151	United Kingdom 1,276; West Germany 1,157; Poland 830; Denmark 720.
Sand, excluding metal bearing	2,858	522	Ivory Coast 381.
Sulfur:			
Elemental	[r]21	42	NA.
Sulfur dioxide	1,377	1,322	Sweden 1,286.
Sulfuric acid value, thousands	$2,572	$2,556	NA.
Talc, steatite, soapstone, pyrophyllite	55,318	61,674	United Kingdom 13,729; Sweden 12,003; West Germany 11,580.
Other:			
Crude	1	58	West Germany 57.
Slag, dross, and similar waste, not metal bearing	12,800	893	All to West Germany.
Building materials of asphalt, asbestos and fiber cement, and unfired nonmetals, n.e.s	6,461	11,950	Denmark 11,667.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	45	1,059	Mainly to Faroe Islands.
Carbon black	8	6	NA.
Coal and coke, including briquets:			
Anthracite and bituminous coal	31,120	95,731	West Germany 63,034.
Coke and semicoke	14,940	19	NA.
Peat, including peat briquets and litter	6	--	
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	[r]57,849	101,416	Mainly to United Kingdom.
Refinery products:			
Gasoline, including natural do	[r]4,857	4,397	Sweden 2,130; Belgium-Luxembourg 814; Denmark 594; Netherlands 558.
Kerosine and jet fuel do	[r]609	240	Italy 160; Denmark 73.
Distillate fuel oil do	4,670	6,585	Sweden 3,818; Denmark 1,726.
Residual fuel oil do	[r]8,230	6,933	Sweden 2,865; Denmark 2,545; United Kingdom 866.
Lubricants do	[r]11	5	Sweden 3; Denmark 1.
Mineral jelly and wax do	([1])	1	Mainly to Denmark and Sweden.

See footnotes at end of table.

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Table 2.—Norway: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum —Continued			
Refinery products —Continued			
Other:			
Liquefied petroleum gas thousand 42-gallon barrels	147	101	Denmark 44; Sweden 28; United Kingdom 24.
Nonlubricating oils, n.e.s. do	r72	11	Sweden 8; Finland 22; Denmark 1.
Petroleum coke do	r117	277	U.S.S.R. 176; Netherlands 64; United Kingdom 27.
Unspecified do	(1)	12	Mainly to Faroe Islands.
Total do	r18,713	18,562	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	17,309	18,538	Netherlands 7,950; Spain 4,804; Denmark 4,364.

rRevised. NA Not available.
1Less than 1/2 unit.

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Table 3.—Norway: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite	6,143	3,473	West Germany 1,519; Greece 1,100; Sweden 854.
Alumina	1,270,459	1,342,811	Australia 425,258; Jamaica 373,381; Surinam 287,255.
Metal including alloys:			
Scrap	35	35	Sweden 23; Iceland 12.
Unwrought	19,385	23,561	U.S.S.R. 11,986; Sweden 7,967.
Semimanufactures	31,711	36,887	West Germany 16,483; Sweden 6,438; Finland 3,032.
Antimony metal including alloys	52	40	United Kingdom 20; People's Republic of China 10; Italy 10.
Arsenic trioxide, pentoxide, acids	68	89	Sweden 78; People's Republic of China 10.
Chromium:			
Chromite	84,501	68,862	Turkey 39,373; Greece 12,733; Iran 7,970.
Oxide and hydroxide	224	373	U.S.S.R. 135; Poland 130; West Germany 106.
Cobalt:			
Oxide and hydroxide	10	19	Belgium-Luxembourg 17; Canada 1; United Kingdom 1.
Metal including alloys, all forms	5	4	West Germany 2; Sweden 2.
Copper:			
Oxide and hydroxide	178	141	Finland 115; West Germany 16.
Copper sulfate	1,277	1,785	U.S.S.R. 671; West Germany 542.
Metal including alloys:			
Scrap	1,121	1,005	Denmark 740.
Unwrought	3,050	3,445	United Kingdom 1,938; Poland 750; Belgium-Luxembourg 500.
Semimanufactures	27,273	28,265	Sweden 7,910; West Germany 6,673; United Kingdom 5,606; Belgium-Luxembourg 3,781.
Gold metal, worked or partly worked troy ounces	20,930	38,902	West Germany 20,191; United Kingdom 15,143.
Iron and steel:			
Ore and concentrate	37,766	163,512	U.S.S.R. 90,680; Sweden 72,698.
Metal:			
Scrap	r53,337	71,336	Netherlands 32,025; West Germany 18,834; Denmark 11,114.
Pig iron, ferroalloys, similar materials	16,017	16,410	West Germany 4,701; Finland 3,275; Canada 2,740; United Kingdom 2,543; Sweden 2,039.
Steel, primary forms	r131,900	139,244	Netherlands 127,534.
Semimanufactures:			
Bars, rods, angles, shapes, sections	r326,591	289,069	West Germany 84,733; Sweden 36,309; France 35,891; Hungary 30,714.
Universals, plates, sheets	r711,961	649,594	Japan 151,128; West Germany 146,125; Sweden 75,437.
Hoop and strip	r39,034	32,808	West Germany 10,672; France 5,624; Belgium-Luxembourg 5,284; Sweden 4,280.
Rails and accessories	r13,209	14,421	Sweden 6,805; West Germany 6,399.
Wire	r12,409	15,748	United Kingdom 4,306; Belgium-Luxembourg 4,285; Sweden 3,766; Netherlands 1,537.
Tubes, pipes, fittings	177,344	127,827	West Germany 43,575; United Kingdom 19,653; France 15,986; Sweden 14,064.
Castings and forgings, rough	3,548	2,553	Denmark 1,113; Sweden 645; West Germany 345.
Total	1,284,096	1,132,020	
Lead:			
Oxide	615	950	United Kingdom 493; West Germany 416.
Metal including alloys:			
Scrap	38	1	NA.
Unwrought	12,871	14,663	United Kingdom 7,808; Sweden 3,021; Denmark 1,879.
Semimanufactures	1,219	1,290	Netherlands 476; West Germany 332; Belgium-Luxembourg 274; Sweden 176.
Magnesium metal including alloys:			
Unwrought value, thousands	r$281	$51	NA.
Wrought	20	13	Italy 2; Sweden 1; United States 1.
Manganese:			
Ore and concentrate	r1,072,944	982,384	Republic of South Africa 349,687; Gabon 231,259; Brazil 172,815.
Oxide	553	91	Belgium-Luxembourg 63; United Kingdom 25.
Metal including alloys, all forms	847	1,216	Republic of South Africa 1,140.
Mercury 76-pound flasks	r261	406	Algeria 261; People's Republic of China 87.
Molybdenum metal including alloys, all forms	3	4	United Kingdom 2; Austria 1.
Nickel:			
Matte, speiss, similar materials	79,337	71,329	Canada 63,866.

See footnotes at end of table.

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Table 3.—Norway: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Nickel —Continued			
Metal including alloys:			
Unwrought	103	684	Finland 619.
Semimanufactures	352	286	West Germany 141; United Kingdom 73; Sweden 29; United States-Puerto Rico 25.
Platinum-group metals and silver:			
Waste and sweepings ____ kilograms	13,755	15,138	Sweden 12,735; Denmark 1,116.
Metals including alloys:			
Platinum-group ____ troy ounces	3,376	2,894	United Kingdom 1,479; West Germany 643; U.S.S.R. 643.
Silver ____ thousand troy ounces	r2,689	3,338	United Kingdom 2,040; West Germany 992.
Tin:			
Oxide	11	1	NA.
Metal including alloys:			
Scrap	49	52	Japan 39; Sweden 12.
Unwrought	787	805	United Kingdom 450; Denmark 187; Malaysia 71.
Semimanufactures	401	371	United Kingdom 246; West Germany 68; Denmark 31.
Titanium:			
Ore and concentrate	80	--	
Oxide	282	713	West Germany 570.
Tungsten metal including alloys, all forms	2	1	Mainly from United Kingdom.
Uranium and thorium:			
Oxides, Including rare-earth oxides	107	53	United States 30; France 10; West Germany 10.
Metals including alloys, all forms value, thousands	$491	--	
Zinc:			
Ore and concentrate	61,983	72,146	Sweden 58,418; Australia 9,729.
Oxide and pentoxide	1,479	1,929	East Germany 1,636; Sweden 191.
Metal including alloys:			
Scrap	2,693	3,155	Sweden 2,375; Denmark 780.
Blue powder	1,024	39	France 16; West Germany 10; Netherlands 8.
Unwrought	4,140	3,099	United Kingdom 882; Poland 781; U.S.S.R. 501.
Semimanufactures	1,263	1,306	France 639; West Germany 219; United Kingdom 158; Netherlands 135.
Other:			
Ores and concentrates	298	149	Australia 125; Sweden 15.
Ash and residue containing nonferrous metals	25,571	25,040	Sweden 24,210.
Metals including alloys, all forms:			
Metalloids	r10	10	United Kingdom 9; West Germany 1.
Alkali, alkaline-earth, rare-earth metals	72	221	United States 75; United Kingdom 73; West Germany 35.
Pyrophoric alloys	5	3	United Kingdom 2; United States 1.
NONMETALS			
Abrasives:			
Pumice, emery, natural corundum	r5,440	4,893	West Germany 4,767.
Dust and powder of natural or synthetic precious and semiprecious stones, except diamond ____ kilograms	21	5	Netherlands 2; United Kingdom 1.
Grinding and polishing wheels and stones	1,070	1,000	Austria 266; Sweden 231; United States 165; West Germany 130.
Asbestos	5,629	5,134	U.S.S.R. 2,237; Canada 1,277; West Germany 1,248.
Barite and witherite	75,914	51,589	United Kingdom 15,645; Morocco 9,560; Netherlands 9,452; Turkey 5,910.
Boron materials:			
Crude natural borates	5,509	5,321	United States 3,681; West Germany 800; Netherlands 640.
Oxide and acid	298	282	United States 227; France 48.
Cement, hydraulic	5,420	9,712	Denmark 2,370; France 2,020; Belgium-Luxembourg 1,816; United Kingdom 1,607.
Chalk	7,918	9,276	Denmark 4,579; Sweden 2,878; France 1,241.
Clays and clay products:			
Crude:			
Fuller's earth, Dinas earth, chamotte	344	357	United States 246; United Kingdom 89.
Kaolin	77,800	76,585	United Kingdom 73,468.
Other	71,261	88,579	United Kingdom 31,623; Greece 19,256; Italy 19,256.
Products:			
Refractory	r23,279	18,232	Sweden 4,158; United Kingdom 3,413; Denmark 2,797; West Germany 2,695.

See footnotes at end of table.

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Table 3.—Norway: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Clays and clay products —Continued			
Products—Continued			
Nonrefractory value, thousands	r$7,475	$7,386	West Germany $2,191; Netherlands $1,693; Sweden $1,372.
Cryolite and chiolite	2,145	3,641	All from Denmark.
Diamond, gem, not set or strung thousand carats	25	70	United Kingdom 20; Belgium-Luxembourg 15; Israel 15.
Diatomite and other infusorial earth	1,292	1,480	Iceland 580; United States 427; Denmark 225; Spain 122.
Feldspar	--	103	France 68; Italy 35.
Fertilizer materials:			
Crude:			
Phosphatic	414,490	318,641	U.S.S.R. 166,664; Israel 81,547; United States 55,463.
Potassic	1	15	NA.
Manufactured:			
Nitrogenous	936	4,042	Netherlands 2,662; West Germany 627; Czechoslovakia 612.
Phosphatic	13,140	12,579	Sweden 10,794; Belgium-Luxembourg 1,010.
Potassic	269,520	219,132	France 72,553; Spain 59,575; West Germany 42,675; Israel 25,040.
Other	7,319	5,506	Sweden 5,148; Netherlands 102.
Ammonia	11,550	5,978	Denmark 2,617; Netherlands 2,598; Sweden 758.
Fluorspar	46,180	38,306	United Kingdom 18,458; East Germany 8,903; Spain 5,211.
Graphite, natural	892	981	United Kingdom 725; Sweden 209.
Gypsum and plaster	214,941	189,204	France 75,767; Poland 53,125; U.S.S.R. 37,488.
Lime	14,188	14,273	Denmark 13,249.
Magnesite	4,138	2,523	People's Republic of China 650; Czechoslovakia 585; Austria 562; North Korea 557.
Mica, worked and unworked, all forms	r4,175	2,894	India 1,715; Brazil 644.
Pigments, mineral:			
Natural, crude	87	62	West Germany 43.
Iron oxide, processed	1,803	2,366	Mainly from West Germany.
Precious and semiprecious stones, except diamond, including synthetic stone kilograms	1,132	899	West Germany 268; Republic of South Africa 147.
Salt and brine	313,300	288,615	Netherlands 119,101; United Kingdom 40,679; Tunisia 40,645; East Germany 34,048.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	15,274	32,879	Netherlands 18,431; Belgium-Luxembourg 13,082.
Caustic potash and sodic and potassic peroxides	904	1,220	Sweden 987.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	481	488	Sweden 427; Italy 58.
Slate	2,515	620	Sweden 535; East Germany 77.
Other	10,752	4,747	Sweden 2,160; Denmark 1,153; Iceland 600; East Germany 422.
Worked, all types	3,776	4,485	Sweden 2,138; Portugal 1,541.
Dolomite	3,342	3,307	Sweden 1,802; West Germany 976.
Flint	569	643	Denmark 493; Sweden 126.
Gravel and crushed rock	70,788	67,297	Mainly from Sweden.
Limestone	249,519	236,748	Mainly from United Kingdom.
Quartz and quartzite	308,599	289,920	Spain 205,094; Sweden 55,220; Portugal 28,047.
Sand, excluding metal bearing	r194,711	183,872	Belgium-Luxembourg 93,444; Sweden 55,728.
Sulfur:			
Elemental	19,360	17,929	Poland 12,422; Ireland 3,424.
Sulfur dioxide	11,339	13,116	Mainly from Sweden.
Sulfuric acid	813	521	Sweden 282; Denmark 129; West Germany 67.
Talc, steatite, soapstone, pyrophyllite	3,890	3,047	India 1,627; People's Republic of China 275.
Other:			
Crude	74,106	64,319	Mainly from West Germany.
Slag, dross, and similar waste, not metal bearing	48,463	49,941	Sweden 40,417; Greece 4,353.

See footnotes at end of table.

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Table 3.—Norway: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Other —Continued			
Oxides and hydroxides of magnesium, strontium, barium	584	488	France 171; East Germany 120; United Kingdom 99; West Germany 58.
Building materials of asphalt, asbestos and fiber cement, and unfired nonmetals, n.e.s	r9,854	8,219	Sweden 3,637; Belgium-Luxembourg 1,008; Netherlands 872; Finland 736.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	500	1,511	Belgium-Luxembourg 632; West Germany 324; Denmark 232.
Carbon Black	4,914	4,967	Sweden 2,868; West Germany 1,335.
Coal, all grades, including briquets thousand tons	457	453	Poland 192; United Kingdom 99; United States-Puerto Rico 93.
Coke, all types do	647	650	United Kingdom 449; West Germany 82; France 56.
Peat, including peat briquets and litter	7,300	9,168	Sweden 7,669; U.S.S.R. 935.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	r42,574	59,601	Iran 24,549; Oman 9,533; United Kingdom 8,691; Nigeria 5,434.
Refinery products:			
Gasoline, including natural do	5,236	4,682	Sweden 1,460; Netherlands 975; Belgium-Luxembourg 572.
Kerosine and jet fuel do	r3,232	4,234	Netherlands 1,134; Belgium-Luxembourg 949; United Kingdom 664.
Distillate fuel oil do	7,826	7,617	Netherlands 1,910; Belgium-Luxembourg 1,597; Venezuela 768; United Kingdom 765.
Residual fuel oil do	r2,157	1,901	U.S.S.R. 488; Sweden 375; Netherlands 368.
Lubricants do	r454	605	Sweden 151; United KIngdom 125; Denmark 111; West Germany 68.
Mineral jelly and wax do	63	75	West Germany 38; United Kingdom 13; U.S.S.R. 10; Hungary 6.
Other:			
Liquefied petroleum gas do	121	129	Sweden 77; United Kingdom 34; Netherlands 14.
Nonlubricating oil, n.e.s do	r99	80	France 38; Belgium-Luxembourg 14; Sweden 12.
Bitumen and other residues do	r971	855	Netherlands 267; Denmark 241; Belgium-Luxembourg 137; United Kingdom 136.
Bituminous mixtures, n.e.s do	r16	18	Belgium Luxembourg 8; United Kingdom 5; United States-Puerto Rico 1.
Petroleum coke do	r1,759	1,456	Mainly from United States-Puerto Rico.
Pitch and pitch coke do	r533	602	United Kingdom 308; West Germany 287.
Total do	r22,467	22,254	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	r28,866	25,444	United Kingdom 17,829; Denmark 2,343; Poland 2,180.

rRevised. NA Not available.

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Major items of mineral imports from the United States were coal, coke, asphalt, and iron and steel semimanufactures. Major mineral exports to the United States included crude oil and residual fuel oil, cement, nickel, ferroalloys, aluminum, other nonferrous metals, and iron ore concentrates. United States-Norwegian mineral trade in 1976 is shown in table 4.

Table 4.—Norway: Mineral trade with the United States, 1976[1]

Commodity	Exports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
METALS				
Aluminum metal including alloys	18,718	$17,225	1,506	$1,504
Copper metal including alloys	1	220	NA	948
Iron and steel metal:				
Ferroalloys	91,756	35,453	104	169
Steel, primary forms	--	--	6	7
Semimanufactures:				
Bars and angles	714	1,110	90	67
Plates and sheets	1	1	196	182
Hoop and strip	--	--	20	54
Wire	230	168	133	211
Tubes and pipes	1	14	2,923	4,683
Castings and forgings	NA	1	193	324
Lead metal including alloys	--	--	15	59
Manganese ore and concentrate	--	--	20,000	505
Nickel metal including alloys	NA	60,629	18	219
Platinum-group metals and silver:				
Ores	NA	287	--	--
Metals:				
Platinum group	(2)	2,267	--	--
Silver metal including alloys	NA	11	--	--
Radioactive and associated materials	NA	37	40	153
Tin metal including alloys	--	--	NA	1
Zinc metal including alloys	1,062	871	--	--
Other nonferrous metals:				
Base metals including alloys	11,350	21,769	117	177
Scrap	352	1,019	18	22
NONMETALS				
Abrasives, natural, including diamond	--	--	674	132
Cement	240,529	4,410	--	--
Clays and refractory materials	443	108	1,867	198
Fertilizer materials: Crude, phosphatic	--	--	55,279	2,104
Salt, sodium chloride	18,132	117	--	--
Stone, sand and gravel:				
Dimension stone	2	3	--	--
Crushed and broken stone, sand and gravel	1,635	178	--	--
Sulfuric acid	12	202	--	--
Other, crude	10	5	--	--
MINERAL FUELS AND RELATED MATERIALS				
Coal, all types	NA	37	112,547	6,823
Gas, natural and manufactured	(2)	2	--	--
Petroleum:				
Crude and partly refined	2,666,283	261,764	--	--
Refinery products:				
Residual fuel oil	133,228	9,946	--	--
Lubricants	2	5	1,429	975
Petroleum jelly and mineral waxes	NA	1	--	--
Petroleum coke, asphalt, etc	1	1	175,465	18,682
Total	XX	417,861	XX	38,188

NA Not available. XX Not applicable.
[1]Data may differ from those reported elsewhere in this chapter owing to a difference in source.
[2]Less than 1/2 unit.

Source: U.S. Department of Commerce, Bureau of the Census.

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COMMODITY REVIEW

METALS

Aluminum.—The recovery of the aluminum market in 1977 initially improved financial conditions, but prices remained depressed. Lack of rain caused power shortages, and power was imported or in some instances metal production was curtailed. Aluminum production was at about 90% of capacity.

Elkem-Spigerverket increased its share of interest in Mosal Aluminium A/S from 50% to 55%, and Aluminum Co. of America's (Alcoa) share was reduced to 45%.

The Norwegian Government approved the expansion of ASV's Hoyanger smelter located on the Sognefjord and authorized utilization of several rivers in the area for generating power. By 1981, the plant's annual capacity is to be increased from the present 28,000 tons to 75,000 tons per year. Recent investments at the site, including that in a new casting plant, amounted to $300 million. At yearend, ASV completed reconstruction of two sections of its Ardal (Sognefjord) reduction plant, raising production capacity to 182,000 tons per year.

Norsk Hydro applied to the Government for increased power supplies for its Karmoy Island smelter. The plant's capacity was to be expanded from 120,000 tons to 180,000 tons per year at a cost of $70 million.

Ownership, location, and capacity of Norwegian primary aluminum plants are shown in table 5.

Table 5.—Norway: Producers of primary aluminum

Company	Ownership	Plant location	Yearend annual capacity (thousand metric tons)
A/S AArdal og Sunndal Verk.	Government 75% and Alcan Aluminium Ltd. (Canada) 25%.	AArdal (Sognefjord)	182
		Sunndalsora (Tingvollfjord).	120
		Hoyanger (Sognefjord)	28
Mosal Aluminium A/S	Elkem-Spigerverket A/S 50% and Aluminum Co. of America (Aloca) 50%.	Mosjoen (Vejsnafjord)	95
		Lista Island	82
Norsk Hydro A/S	Government 51% and several private interests 49%.	Karmoy Island	120
Sor-Norge Aluminium A/S	Alusuisse 75%, and Norsk Hydro 10%, several private interests 15%.	Husnes (Hardangerfjord)	72
DNN Aluminium A/S	Alcoa 50% and British Aluminium Co. Ltd. 50%	Tyssedal (near Odda on the Sorfjord).	24

Copper, Lead, Zinc.—To ease the financial difficulties of the copper-mining companies caused by low copper prices, the Norwegian Government in 1977 formally established a Government copper fund amounting to $57 million, $19 million of which was earmarked retroactively for 1976. The fund was to compensate copper mines if the copper price fell 10% under a predetermined "base price" and was to be replenished if copper prices exceeded it. Payments to companies amounted to $15,000 per copper miner per year.

Norway's 12 small complex sulfide ore mines, distributed throughout the country, were operated by 10 independent companies. The ores mined contained mostly copper, lead, zinc, and iron sulfides. Among the more important mines were Sulitjelma Gruber A/S's Fauske mine, east of Bodo (copper, lead, and zinc); Grong Gruber A/S's Royrvik mine, near the Swedish border (copper and zinc); Folldal Verk A/S's Dovre and Kvalsund mines, in southern and northern Norway, respectively (copper, zinc, and pyrites); and Orkla Industrier A/S's Meldal mine, south of Trondheim (copper, zinc, and pyrites).

Some copper ores were processed at Sulitjelma Gruber's 10,000-ton-per-year Sulitjelma copper smelter east of Bodo, but most copper and all lead ores of domestic origin were exported. Det Norske Zinkkompani NS's Odda electrolytic zinc smelter processed all domestic and some imported zinc concentrates.

Iron Ore.—In 1977, the first large (120,000-deadweight-ton) ore carrier was

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loaded at Kirkenes with iron ore pellets from A/S Sydvaranger's taconite operation located north of the Arctic Circle. The vessel's destination was British Steel Corp. at Redcar on the eastern coast of the United Kingdom.

Construction continued on expanding the iron ore loading facilities of Narvik, one of the world's largest ore shipping ports, from 23 million tons to 30 million tons per year. Narvik is the main port on the Atlantic Ocean used by Luosssavaara-Kiirunavaara AB (LKAB), the Swedish iron mining concern. Expenditures at the port during the 1970's will reach $150 million.

A/S Rana Gruber reported the discovery of 20 million tons of recoverable reserves of iron ore in the Valnesfjord area, 100 kilometers east of the Lofoten Islands.

Norsk Hydro secured the mining rights for iron ore deposits at Kodal, west of Tonsberg, southern Norway. Reserves were estimated at 70 million tons, and construction of an 800,000-ton-per-year mine is under consideration.

Three of Norway's iron ore mines were Government-owned: Sydvaranger's Kirkenes mine north of the Arctic Circle, Rana Gruber's Rana mine near Mo, and Fosdalens Bergverks A/S's mine at Verran, in southern Norway. Elkem-Spigerverket's subsidiary, Titania A/S, produced a magnetite concentrate byproduct from its ilmenite mine at Telnes in Sokndal in southern Norway.

Iron, Steel, Ferroalloys.—The Norwegian Government authorized the installation of a fourth electric arc furnace at Elkem-Spigerverket's Salten plant, raising the company's ferrosilicon capacity from 80,000 tons to 112,000 tons per year. In the meantime, the plant will temporarily close one of its three ferrosilicon furnaces because of the Government's electric power quotas.

Elkem-Spigerverket's Bremanger Smeltverk at Svelgen continued production of ferrosilicon and ferrovanadium.

Besides the three major steelmakers—A/S Norsk Jernwerk at Mo i Rana (Government-owned), Elkem-Spigerverket at the Nydalen plant near Oslo, and Stavanger Stal at the Jorpeland (Stavanger) plant on the western coast—about nine more Norwegian companies produced ferroalloys at 15 locations.

Magnesium.—In 1977, Norsk Hydro commissioned a 15,000-ton-per-year magnesium chloride plant at its Porsgrunn factory at Heroya, southern Norway.

The deteriorating market outlook for magnesium and escalating production costs in Norway forced Norsk Hydro to definitely shelve its plans to start work in 1978 on a 100,000-ton-per-year magnesium plant at Mongstad on the Fensfjorden. Thus, the company's 70,000-ton-per-year Porsgrunn plant remained the country's only magnesium smelter.

Nickel, Cobalt, Platinum-Group Metals.—Operating rates increased somewhat in 1977, but remained far below the maximum rates of earlier years at Falconbridge Nikkelverk A/S's Kristiansand refinery, a subsidiary of Falconbridge Nickel Mines Ltd. of Canada. The company processed imported copper-nickel matte into nickel, cobalt, some copper, and precious metals.

Titanium.—Ilmenite production increased owing to new capacity commissioned in 1975 at Titania's Sokndal mine in Dalane, southern Norway. The company, a subsidiary of N L Industries, Inc. (United States), produced some titanium pigment from ore at its Kristiansand plant, but most mine production was exported.

Vanadium.—Elkem-Spigerverket produced vanadiferous iron ores at the Nesset mine, east of Molde on the western coast.

NONMETALS

Cement.—In 1977, A/S Norcem, the country's only cement producer, operated three cement plants with a total capacity of 2.3 million tons per year. The 1-million-ton-per-year Brevik and Slemmestad plants were located in the south; the 0.3-million-ton-per-year Kjopsvik plant was in the north of the country.

Fertilizer Materials.—Norsk Hydro discovered 13 million tons of phosphate ore reserves in association with 32 million tons of iron ore at Kodal, Vestfold County.[4] The company was studying a project to produce from the ore 300,000 tons per year of apatite concentrate and 80,000 tons per year of magnetite at a capital cost of $150 million.

Norsk Hydro continued to account for most Norwegian fertilizer materials. Of the company's ammonia capacity of 830,000 tons per year, 500,000 tons was located at Heroya in southern Norway on the Frierfjord.

MINERAL FUELS

In 1977, 70% of Norway's energy output consisted of petroleum and gas, and 28% was hydroelectric power; coal producion was insignificant. The country was a net exporter of oil and natural gas, the latter for the first time.

Norway's supply and apparent consumption of fuels and power in 1976 and 1977 are shown in table 6.

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Table 6.—Norway: Supply and apparent consumption of fuels and power

(Million tons of standard coal equivalent[1])

Year	Total energy	Coal	Petroleum and refinery products	Natural gas	Hydroelectric power[2]
1976:					
Production[3]	31.0	0.5	20.4	--	10.1
Imports	16.9	1.1	15.8	--	--
Exports	24.8	.1	23.9	--	.8
Apparent consumption	23.1	1.5	12.3	--	9.3
1977:					
Production[3]	34.1	.5	20.3	3.6	9.7
Imports	18.5	.9	17.3	--	.3
Exports	27.3	.2	23.3	3.6	.2
Apparent consumption	25.3	1.2	14.3	--	9.8

[1]1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2]Secondary energy included in trade.
[3]Primary energy only.

Source: U.S. Embassy, Oslo, Norway. Foreign Economic Trends and Their Implications for the U.S.: Norway. U.S. Department of Commerce. 78-086, August 1979.

Coal.—According to the Norwegian Ministry of Industry, coal and uranium were found in the Svalbard Islands by an Arctic expedition partly financed by the Federal Republic of Germany. The uranium was located at Dickson Fjord and the coal at Gipsfjord, both on Vestspitsbergen Island.

Government-controlled Stora Norske Spitsbergen Kulkompani A/S decreased production of low-sulfur coal at the Longyearbyen mine on Spitsbergen Island. Production of coal at the Svea mine near Van Mijenfjorden is now scheduled to start in 1983. The U.S.S.R. continued to mine an estimated 400,000 tons of coal per year at Barentsburg and Piramiden near Longyearbyen.

Petroleum and Natural Gas.—The Norwegian sector of the North Sea was the scene of continuing development and of efforts to cope with setbacks and delays in production. One setback was a blowout at platform B of the Ekofisk oilfield (capped and controlled in April) which caused a slight decrease in North Sea oil output in 1977.

The Norwegian Petroleum Directorate lowered its future oil production estimates for the Ekofisk and Statfjord oilfields. Current proven recoverable reserves in the Norwegian North Sea are put at about 680 million tons of oil, 700 billion cubic meters of gas, and 20 million tons of natural gas liquids, totaling 1.4 billion tons of oil equivalent.[5]

At yearend, the Norwegian Government announced the formation of a new Oil and Energy Ministry, which will have five divisions.[6] Two of the divisions will be responsible for oil and one each for hydroelectric power, planning, and administration. Previously, North Sea oil was under the jurisdiction of the Ministry of Industry.

During 1977, the Ministry of Industry recommended to the Parliament further allocations of blocks in the North Sea to counteract a possible future decline in the level of oil output. Of 15 blocks in the Statfjord area proposed for announcement, 8 were to be allocated in the spring of 1978. It was hoped to determine if sufficient reserves exist to sustain a North Sea trunkline to the Norwegian mainland.

The year 1977 marked the start of natural gas deliveries from Ekofisk Field to Emden, Federal Republic of Germany, and from there to consumers in the Federal Republic of Germany, the Netherlands, Belgium-Luxembourg, and France, and also from Frigg Field to St. Fergus on the United Kingdom's eastern coast. Norway's natural gas deliveries in 1977 from all fields were about 2.7 billion cubic meters.

In August, Norsk Polar Navigasjon A/S spudded a well on the Tromsobreen anticline in South Spitsbergen. The well was later suspended for the winter.

Of a total of 16 holes drilled in 1977 in the Norwegian sector of the North Sea, there were 4 wildcats, 5 exploration wells, and 7 appraisal wells; there were no development wells.

Ekofisk Field is located in block 2/4, 270 kilometers southwest of Lista, in 72 meters of water. It is the center of a development program involving seven other fields (West Ekofisk, Cod, Tor, Edda, Edfisk, Albuskjell, and Valhall). The oil goes by a 34-inch, 354-kilometer pipeline to Teesside, United Kingdom, and the gas by a 36-inch, 431-kilometer pipeline to Emden, Federal Republic of Germany. All adjoining fields are

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to be linked by pipeline to Ekofisk Center, the central platform of Ekofisk Field. The project embraces 25 steel structures standing on the seabed, 12 of which are drilling platforms. Ekofisk itself has 3 drilling platforms totaling 30 oil wells, 5 gas wells, and 3 natural gas liquid wells.

The following tabulation gives details on the other seven fields involved in the Ekofisk development program:

Field	Location		Depth of water (meters)	No. of drilling platforms	No. of wells	Diameter (inches) and type of pipeline to Ekofisk Center
	Block	Orientation to Ekofisk				
In production:						
West Ekofisk	2/4	8 kilometers northwest	67	1	10	24.
Cod	7/11	80 kilometers northwest.	79	1	6	16 (oil and gas).
Planned:						
Tor	2/4 and 2/5	12 kilometers northeast.	69	1	15	12 (oil) and 14 (gas).
Edda	2/7	13 kilometers southwest.	72	1	10	10 (oil) and 12 (gas).
Edfisk	Do.	24 kilometers south	73	2	19 and 30	24 (oil) and 30 (gas).
Albuskjell	2/4 and 1/6	14 kilometers northwest.	67	2	12 and 1	18 (oil) and 24 (gas).
Valhall	2/10	32 kilometers southeast	70	1	NA	NA.

NA Not available.

Statfjord Field's Norwegian sector is located in blocks 33/9 and 33/12, 200 kilometers northwest of Mongstad in 146 meters of water. The concrete A platform was installed in 1977, the Concrete B platform will be installed in 1981, and a third platform was under consideration. Crude oil transportation will be initially by tankers. A pipeline across the Norwegian trench to Sotra near Bergen was also under study.

On December 31, 1977, Norwegian refinery throughput capacity remained at 12.9 million tons per year.[7]

[1]Physical scientist, Branch of Foreign Data.
[2]Where necessary, values have been converted from Norwegian kroner (NKr) to U.S. dollars at the rate of NKr5.3 = US$1.00.
[3]U.S. Embassy, Oslo, Norway. State Department Airgram A-012, Feb. 10, 1978, p. 3.
[4]Industrial Minerals. No. 123, December 1977, p. 71.
[5]Petroleum Economist. V. 138, No. 4, April 1978, p. 137.
[6]The Oilman. Jan. 4, 1978, p. 3.
[7]Oil and Gas Journal. V. 75, No. 53, Dec. 26, 1977.

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The Mineral Industry of Pakistan

By David E. Morse[1]

Pakistan's mineral industry played a minor role in the nation's economy in 1977. Development of the mineral industry has been hampered by the Governments' low-priority view of the mineral and other industries based on mineral products. A paucity of trained personnel and the non-availability of modern mining equipment have also impeded progress in the mineral sector. The capital-intensive nature of mineral development and the complexity of Pakistan's mining laws have deterred active participation by private investors.

The presence of a number of Federal and provincial agencies promoting mineral development caused confusion owing to the overlapping nature of some of these agencies. Pakistan Mineral Development Corp. (PMDC) was responsible for exploration, evaluation, and exploitation of mineral commodities (excluding petroleum, natural gas, and uranium) throughout Pakistan. Oil & Gas Development Corp. (OGDC) was responsible for exploration, development, and exploitation of Pakistan's oil and natural gas resources, and the Pakistan Atomic Energy Commission was responsible for uranium exploration and development. Provincial agencies involved with mineral development were the Baluchistan Development Authority (BDA), Punjab Mineral Development Corp. (PUNJMIN), and the Sarhad Development Authority of North-West Frontier Province. In addition, the Agency for the Federally adninisterod Tribal Areas was responsible for mineral development in tribal areas in Baluchistan and North-West Frontier Provinces. Resource Development Corp. (RDC) was concerned with the development of the Saindak copper deposits in western Baluchistan.

Widespread civil disturbances following the March 1977 general elections and severe floods combined to limit Pakistan's economic growth to 2.8% in fiscal 1976-77[2] compared with a projected increase of 8.1%. The civil unrest was abated when the Army took over the Government and established the Martial Law Administration (MLA) in early July.

PRODUCTION

Production of mineral commodities in Pakistan was of only domestic importance in 1977 as most of the country's mineral output was consumed locally. Mining and quarrying registered a growth of 5% in 1977 but contributed only about 0.5% to the country's gross domestic product. Crude oil and natural gas were bright spots as oil production rose 45% to 3.7 million barrels. Pakistan produced significant quantities of clays, coal, gypsum, rock salt, sand and gravel, and stone. In addition, small amounts of barite, bauxite, chromite, marble, ochers, soapstone, and sulfur were produced during the year. Pakistan also utilized domestic raw materials for the manufacture of cement and fertilizers.

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Table 1.—Pakistan: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Aluminum: Bauxite, gross weight	--	124	151
Antimony ore:			
Gross weight	120	55	94
Metal content[e]	24	[r]11	19
Chromium: Chromite, gross weight	9,961	10,872	8,400
Iron and steel: Mild steel products thousand tons	231	243	277
Manganese ore, gross weight	[r]83	64	53
NONMETALS			
Abrasives, natural: Emery stone	710	907	657
Barite	4,598	9,380	17,718
Cement, hydraulic thousand tons	3,120	3,138	3,165
Chalk	712	1,376	1,105
Clays:			
Bentonite	676	747	1,089
Fire clay	26,238	28,019	53,100
Fuller's earth	12,141	16,000	18,000
Kaolin (china clay)	366	346	566
Other	[r]71,735	60,000	65,000
Feldspar	2,671	2,705	3,699
Fertilizer materials, manufactured:			
Nitrogenous:			
Gross weight	783,150	772,336	743,449
N content	333,326	326,325	314,891
Phosphatic, gross weight	42,330	60,410	70,489
Fluorspar	[r]4	10	--
Gypsum, crude	[r]570,079	447,000	283,000
Magnesite, crude	[r]2,665	3,246	1,567
Pigments, mineral, natural: Other	1,713	15,795	14,310
Salt:			
Rock thousand tons	409	375	385
Marine do	131	144	114
Total do	540	519	499
Sand and gravel:			
Gravel	54,150	46,000	40,000
Sand:			
Bajri and common	58,796	29,549	14,131
Glass	32,003	44,668	66,088
Sodium and potassium compounds:			
Caustic soda	38,241	30,660	25,914
Soda ash, manufactured	79,215	63,288	60,579
Stone:			
Aragonite and marble	33,219	29,000	34,000
Dolomite	483	1,162	2,723
Limestone thousand tons	3,710	3,000	3,895
Crushed stone do	172	1,740	693
Strontium minerals: Celestite	1,033	603	365
Sulfur	1,227	1,326	1,160
Talc and related materials: Soapstone	3,220	5,035	9,179
MINERAL FUELS AND RELATED MATERIALS			
Coal, all grades thousand tons	[r]1,313	1,349	[e]1,380
Gas, natural (sales) million cubic feet	164,101	183,635	180,324
Natural gas liquids[e] thousand 42-gallon barrels	25	32	32
Petroleum:			
Crude do	2,190	2,562	3,720
Refinery products:			
Gasoline do	2,090	2,152	4,015
Kerosine do	2,166	2,005	1,840
Jet fuel do	3,184	3,176	3,221
Distillate fuel oil do	5,621	5,822	5,120
Residual fuel oil do	8,460	9,032	6,057
Lubricants do	587	501	609
Other do	1,319	1,420	926
Refinery fuel and losses do	913	834	2,057
Total do	24,340	24,942	23,845

[e]Estimate. [p]Preliminary. [r]Revised.

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TRADE

Pakistan's trade deficit continued to increase in fiscal 1976-77 as imports increased 12% to $2.3 billion[3] and exports were essentially stagnant at $1.14 billion. The trade deficit for the July to December 1977 period averaged $111 million per month. Pakistan was able to finance a substantial portion of the deficit with foreign aid and remittances from Pakistanis working overseas.

During fiscal 1976-77, Pakistan's mineral trade deficit was approximately $736 million. Cement, chromite, and petroleum products were the only significant mineral exports. Imports of crude oil and petroleum products increased from $377 million in fiscal 1975-76 to $426 million in fiscal 1976-77. Other major mineral imports included iron and steel products and chemical fertilizers. Pakistan planned to decrease its mineral trade deficit by building fertilizer plants and a major steel mill and increasing domestic crude oil production.

Table 2.—Pakistan: Imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1974-75	1975-76
METALS		
Aluminum:		
Oxide and hydroxide	273	200
Metal including alloys:		
Scrap	1,740	7,154
Unwrought and semimanufactures	12,900	2,161
Arsenic trioxide, pentoxide, acids	5	43
Chromium oxide and hydroxide	3	3
Cobalt oxide and hydroxide	1	2
Copper:		
Ore and concentrate	45	64
Metal including alloys:		
Scrap	2,250	1,628
Unwrought and semimanufactures	7,161	2,266
Iron and steel:		
Ore and concentrate, including roasted pyrite	32	125
Metal:		
Scrap	134,024	138,334
Pig iron, sponge iron, powder, shot	119,581	28,332
Ferroalloys	7,712	3,502
Steel, primary forms	138,391	46,348
Semimanufactures	283,193	342,080
Lead:		
Ore and concentrate	78	347
Oxide	487	550
Metal including alloys, all forms	2,267	985
Manganese:		
Ore and concentrate	194	--
Oxide	836	1,000
Mercury 76-pound flasks	71,123	1,135
Nickel metal including alloys, all forms	139	106
Platinum-group and silver metals including alloys troy ounces	1,768	645
Tin metal including alloys, all forms	274	137
Titanium oxide	603	772
Zinc:		
Oxide	427	926
Metal including alloys:		
Scrap and blue powder	211	1,615
Unwrought and semimanufactures	4,917	1,994
Other:		
Ores and concentrates	60	--
Ash and residue containing nonferrous metals	165	69
Oxides, hydroxides, peroxides	27	115
Metals including alloys, all forms:		
Metalloids	15	1
Alkali, alkaline-earth, rare-earth metals	35	39
Base metals including alloys, all forms, n.e.s	123	1,150
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, etc	561	423
Grinding and polishing wheels and stones	198	239
Asbestos, crude	4,374	5,647
Barite and witherite	1,185	201
Cement	107	123
Chalk	2,167	3,815

See footnotes at end of table.

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Table 2.—Pakistan: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity		1974-75	1975-76
NONMETALS —Continued			
Clays and clay products:			
Crude:			
Bentonite		85	--
Fuller's earth		1,656	25
Kaolin		1,876	2,483
Other		1,347	1,093
Products:			
Refractory		5,985	7,414
Nonrefractory		521	32,028
Diatomite		66	--
Feldspar and fluorspar		22	35
Fertilizer materials:			
Crude:			
Nitrogenous		8,484	24
Phosphatic		23,782	34,444
Manufactured:			
Nitrogenous		300,707	43,320
Phosphatic		11,177	17,967
Potassic		1	1
Mixed		20,673	6,442
Ammonia		11	8
Graphite, natural		112	552
Magnesite		598	829
Pigments, mineral, including processed iron oxides		298	883
Precious and semiprecious stones, excluding diamond	kilograms	3,017	1,460
Sodium and potassium compounds:			
Caustic soda		2,734	34,013
Caustic potash		254	31
Sodium and potassium peroxides		4	105
Stone, sand and gravel:			
Dimension stone, crude and partly worked		83	21
Gravel and crushed rock		--	7
Quartz and quartzite		55	--
Sand, excluding metal bearing		1	21
Sulfur:			
Elemental, all forms		20,752	7,077
Sulfuric acid		37	16
Talc, steatite, soapstone, pyrophyllite		186	20
Other:			
Crude		901	2,025
Bromine, iodine, fluorine		3	1
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		27	133
Carbon black		1,962	1,292
Coal and coke, including briquets		77,661	39,625
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	18,827	20,710
Refinery products:			
Gasoline	do.	300	406
Kerosine	do.	2,974	2,350
Jet fuel	do.	13	2
Distillate fuel oil	do.	5,519	5,899
Residual fuel oil	do.	62	28
Lubricants	do.	57	22
Other:			
Paraffin, petroleum jelly, wax	do.	27	75
Unspecified	do.	53	1,198
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		3,533	844

[1]Data are for fiscal years beginning July 1.

COMMODITY REVIEW

METALS

Chromite.—Most of Pakistan's chromite production came from the Zhob Valley region of Baluchistan near Muslimbagh. BDA, with assistance from the Pakistan Council of Scientific and Industrial Research, planned to set up a 20-ton-per-day pilot plant to treat low-grade chromite ores of the Zhob Valley. Government plans for chromite development at Muslimbagh included an 18,000-ton-per-year concentrator, a 15,000-ton-per-year ferrochrome plant, and a refractory brick plant. Chromite production was to be expanded to 40,000 tons per year by 1981.[4]

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Copper.—Seltrust Engineering Ltd. of the United Kingdom completed a feasibility study of the Saindak copper deposits located near the Iranian border in Chagai District, Baluchistan. A 12,500-ton-per-day mine and mill that would produce 165 tons per day of copper concentrate, 250 tons per day of magnetite concentrate, and 205 tons per day of pyrite concentrate was recommended to RDC. The concentrates would be shipped to Port Qasim near Karachi where a copper smelter and facilities to produce sulfuric acid and steel billet would be established. The end products were to be 15,000 tons per year of blister copper, 80,000 tons per year of steel billets, and 150,000 tons per year of sulfuric acid. RDC planned to begin shipments from Saindak in late 1981.

Iron and Steel.—During 1977, Pakistan's steel output came from processing domestic and imported scrap and from shipbreaking operations. More than 100,000 tons of equipment and materials arrived during 1977 from the U.S.S.R. for the new Pipri steelworks that was being built by Pakistan Steel Mills Corp. When completed in fiscal 1980-81, the mill is to produce 1.1 million tons of raw steel per year, employ 15,000 workers, and reduce imports of steel products. Port Qasim, also under construction during 1977, was to handle the imports of iron ore and coal for the new steel mill. Coal and Allied Industries of Australia won a contract to supply 1 million tons of coking coal for the project. Deliveries were to begin at 100,000 tons per year in 1978-79 and increase to 400,000 tons per year.

NONMETALS

Cement.—Cement production from Pakistan's nine cement plants increased modestly during 1977. Owing to increased domestic consumption, cement exports to the Middle East market decreased nearly 90% from fiscal 1974-75 to fiscal 1976-77. Pakistan's projected cement consumption for 1980 was 5.1 million tons per year, and State Cement Corp. has initiated several projects to increase existing capacity by 1.5 million tons per year. Plants at Javedan and Mustekham were to be expanded by 300,000 tons per year each, and a new unit of equal capacity was to be built with Iranian assistance at Spintangi. In addition, Japan was to lend Pakistan $28 million for new cement plants at Dandot and Thatta.

Fertilizer Materials.—Imports of nitrogenous and phosphatic fertilizers were valued at nearly $66 million in fiscal 1976-77. Pakistan did not import potassic fertilizers in 1977 and had no facilities for their production.

Nitrogenous.—During 1977, Pakistan had four fertilizer plants producing nitrogenous fertilizers. Esso Pakistan Fertilizer Co., Ltd., located at Daharki utilized natural gas from the Mari natural gas field for the production of urea using the Kellogg ammonia and Toyo Koatsu total recycle urea process. Rated capacity was 80,000 tons per year (nitrogen content) urea (46-0-0), although the plant operated above rated capacity during 1977. The Dawood Hercules Chemicals Ltd. plant located at Chickoki, utilizing Sui natural gas and the same process as the Esso plant, had a rated capacity of 158,000 tons per year (nitrogen content) urea. National Fertilizer Corp. (NFC) of Pakistan operated two fertilizer plants at Multan and Daudthel with a combined capacity of nearly 54,000 tons per year (nitrogen content) in a variety of products.

During 1977, two major new plants were under construction. Pakarab Fertilizer Ltd., a joint venture of NFC and Abu Dhabi National Oil Co., was building a $127 million expansion to NFC's Multan fertilizer plant. The expansion, to be in production in late 1978, is to have nitric acid, ammonia, ammonium nitrate, calcium ammonium nitrate, and complex fertilizer (21-21-0) facilities. NFC, with financing provided by Saudi Arabia and the Asian Development Bank, was building a 1,000-ton-per-day ammonia, 1,750-ton-per-day urea facility at Mirpur Mathelo near Sukpur, Sind. The plant is to utilize natural gas from the Mari field as feedstock and be commissioned in 1979.

Phosphatic.—PD-NCB Consultants Ltd. of the United Kingdom completed an initial study of the phosphate potential of the Hazara District of North-West Frontier Province in 1977 and began development of a 120-ton-per-day phosphate mine at Kakul which was to supply the needs of NFC's superphosphate plants at Jaranwala and Faisalabad. PD-NCB was also investigating phosphate deposits at Lagarban in the Abbottabad District during the year.[5]

Salt.—During 1977, rock salt production in Pakistan increased 2.7% to 385,000 tons.[6] PMDC planned to upgrade salt mining operations in the Salt Range to bring production to 535,000 tons per year. Solar-evaporated salt was produced by 19 small coastal operations during 1977.

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MINERAL FUELS

Coal.—PMDC planned to increase its coal output from 250,000 tons to 1.6 million tons per year by 1983. The major development would be a 3,000-ton-per-day operation that would feed a new 250-megawatt powerplant at Janshoro, Sind, from the Lakera coalfields.

Natural Gas.—OGDC discovered natural gas in commercial quantities in late October with the completion of Pir Koh 1 (29°08' N. 69°05' E.) in Baluchistan, about 50 kilometers north of the large Sui natural gas field. Seven development wells were completed in Pakistan during 1977, five in the Mari field and two in the Sui field.

Gross natural gas production increased to 5 billion cubic meters in 1977. Pakistan Petroleum Ltd. (PPL) sold 4.35 billion cubic meters from the Sui field, and Pakistan Oilfields Ltd. (POL) sold 165 million cubic meters of desulfurized gas that was produced in association with crude oil from the Meyal oilfield during the year. Output from the Mari field averaged approximately 1 million cubic meters of natural gas per day and was used by the urea fertilizer plant at Daharki.

Sui Gas Transmission Co., Ltd., completed the Indus Right Bank Gas Pipeline in 1977. The 45.7-centimeter-diameter, 488-kilometer-long, high-pressure line had a free-flow capacity of 3.85 million cubic meters per day and raised the gas transmission capacity south of the Sui field to over 8 million cubic meters per day. Total cost of the project was $90 million.

Petroleum.—Crude oil production increased 45% in 1977, but the output of 10,000 barrels per day provided only 11% of the nation's requirements. The Meyal oilfield was the major producer, averaging nearly 6,800 barrels per day. Development wells completed in 1977 were Meyal No. 7 drilled by POL and the Tüt No. 7 drilled by OGDC. OGDC spudded Tüt No. 8 in 1977 and was rigging up for Tüt No. 9 at yearend.

PPL (as operator) and Amoco Pakistan Exploration Co., in a joint venture, spudded Adhi 5 (38°08' N. 73°09' E.) during August in PPL's East Potwar concession area. The four previous wells drilled in this concession were abandoned because of high pressure or failure to penetrate the objective horizon owing to structural complexity. Texasgulf Inc., in partnership with POL, spudded Karak 1 (33°06' N. 71°13' E.) in August and was drilling at yearend. OGDC spudded the Kot Rum 1 wildcat (26°17' N. 70°09' E.) about 105 kilometers northeast of the Sui gasfield in December with a newly acquired 20,000-foot-capacity rig.

OGDC planned to begin development of the Dhodak oilfield field in 1978. The 10-well, $125 million program, expected to produce 22,500 barrels per day of oil and 64 million cubic feet per day of natural gas, is to be completed in 1981.

Pakistan had three petroleum refineries in operation during 1977. National Refinery Ltd. (NRL) and Pakistan Refinery Ltd., both Government owned and located near Karachi, processed imported crude oil. Attock Oil Co. Ltd. (AOC) processed domestic crude oil at its Rawalpindi refinery in northern Pakistan.

AOC planned to increase the capacity of the Rawalpindi refinery from 11,600 barrels to 31,600 barrels per day to accommodate the increased output of the Tüt and Meyal oilfields. A new 40,000-barrel-per-day refinery was under construction at Multan in south-central Punjab. Crude oil for the refinery, a joint Pakistan-Abu Dhabi venture, was to be imported and transported by pipeline from Karachi. The 12,500-barrel-per-day expansion to NRL's plant is to be commissioned in early 1978. Pakistan's refining capacity is to increase from 106,000 barrels to 181,000 barrels per day by fiscal 1980-81.

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[1]Physical scientist, Branch of Foreign Data.
[2]Pakistan's fiscal year is the year beginning July 1.
[3]Where necessary, values have been converted from Pakistani rupees (PRs) to U.S. dollars at the rate of PRs9.9 = US$1.00.
[4]Industrial Minerals. No. 124, January 1978, p. 52.
[5]Mining Magazine. Pakistan-Phosphate. May 1977, p. 385.
[6]Government of Pakistan, Statistics Division. Pakistan's Key Economic Indicators. V. 12, No. 1, January 1978, p. 16.

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The Mineral Industry of Peru

By Orlando Martino[1]

The real rate of growth of Peru's gross domestic product (GDP) in 1977 declined 1.2% compared with the modest increases in 1975 and 1976 and the average of almost 6% for the 1972-74 period. A positive growth rate of 3.7% had been officially forecast for 1977. The annual average price increase of 1977 was 38% compared with the 45% inflation rate of 1976. During 1977 practically all of Peru's economic sectors experienced declines in real terms, with the exception of the mining industry which grew 30% compared with 9% growth in 1976. However, growth in mineral production was expected to slow to 15% during 1978. The value of output by Peru's mineral industry accounted for 8.3% of the GDP of $12.5 billion[2] at current prices, compared with the 6.3% share in 1976. The value of mineral exports increased 20% to $874 million, providing 52% of Peru's total foreign exchange earnings.

Peru's export-oriented mineral industry was dominated by copper, silver, zinc, iron ore, and lead, in that order. Of lesser importance were bismuth, molybdenum, tungsten, selenium, tellurium, indium, cadmium, and nonmetal such as barite, limestone, and gypsum.

The outstanding mining and mineral fuels developments marking the year were the inauguration of the Cerro Verde-Stage I copper project of Empresa Minera del Perú (Minero Perú) and the beginning of oil delivery at Port Bayóvar through the new trans-Andean pipeline of Petróleos del Perú (Petroperú). Empresa Minera del Centro del Perú (Centromin Perú) achieved a record high in output of refined copper and continued six rehabilitation and expansion projects covering its several operating units.

The Banco Minero del Perú continued assisting the medium and small mining sector with loans totaling the equivalent of $74 million, a 36% increase over 1976 lending in local currency terms. The Banco Minero was evaluating 70 mining projects and investment credit applications from small- and medium-scale mining operations which were estimated to increase export earnings by $29 million. The Banco Minero was applying for a $12 million loan from the Inter-American Development Bank and a $2 million credit from the Andean Development Corporation (CAF) for financing capital goods imports. The Banco Minero obtained a consignment of equipment from Canada valued at Can$5 million to be resold to medium-scale mining operations on easy repayment terms.

The Banco Minero also operated six ore beneficiation plants located in Cajamarca, La Libertad, Ancash, Huancavelica, Ica, and Puno Departments to help small miners. During 1977, 76,000 tons of ore was treated, a 65% increase over ore treated in 1976. The Banco Minero continued giving special attention to gold placer mining, locating several promising prospects. The two most important are at Huaypetue and Alto Laberinto in the Department of Madre de Dios.

In early 1977, the Government issued the Organic Law for the Instituto de Geológia y Mineria (INGEOMIN) granting it administrative and financial autonomy. INGEOMIN supervises the exploration, evaluation, and recording of mineral resources in Peru. With the assistance of the technical missions from France, the Federal Republic of Germany, Japan, and Romania, INGEOMIN was carrying out studies on prospects for nickel, gold, and silver. The Instituto Científico y Tecnológico Minero (INCITEMI) continued its scientific investigations in the areas of geology, mining, and metallurgy.

Government Policies and Programs.—In June the Government announced further tightening of the austerity program that

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had been initiated in September 1976. The austerity program was designed to reduce inflation and to improve Peru's balance of payments by reducing government spending and cutting back public sector imports. By yearend, it was not clear what impact the proposed stabilization program would have on the development projects of the State-owned mining companies.

The Government took several actions during 1977 to improve the investment climate for the private sector. The Government has become more aware that it is not in a position to develop by itself the considerable and varied mineral potential of Peru and was expected to invite the private sector, and foreign, to participate in the development of several known mineral deposits. In particular, the Government expressed interest in providing incentives for gold placer mining and was in the process of drafting relevent legislation. The Government notified the State-owned companies that they will have to finance their own projects rather than depend on government funding as in the past. This indicates that private investors will have greater opportunities to participate in mineral projects in Peru.

In March the Government approved two new laws in the petroleum sector empowering Petroperú to negotiate contracts with foreign oil companies for secondary recovery and for new oil exploration offshore and in the Amazon basin. These laws allow more flexibility in contract terms than was available under the "Peruvian model" contract and were regarded as designed to encourage foreign oil companies to operate in Peru.

A new Industrial Community law (Decree-Law 21789) was promulgated in February that replaced the original law of September 1970. Under the old law, 25% of pretax profits were destined to a firm's "industrial community," with 10% paid out as profit sharing and 15% allocated to purchase shares of the firm's equity until workers, through their industrial community, came to own half of the firm's paid in capital. The new law retains profit sharing but alters the formula so that an industrial community cannot acquire more than one-third of a company's paid in capital. One intent of the law was to resolve the ownership issue and managerial rights.

PRODUCTION

Peru's production of minerals and mineral fuels is shown in table 1. Production of copper, silver, zinc, iron ore, and lead, Peru's five principal mineral commodities in order of export value, increased in 1977—especially mine copper and iron ore, which increased 62% and 32%, respectively. The sharp increase in copper output reflected the startup of the Cerro Verde-Stage I and the first full year of operation of the Cuajone open pit mine in southern Peru. Of the precious metals, mine silver output increased 7% and gold, 20%. Peru was Latin America's most important producer of barite, ranking third in the world.

Peru approached self-sufficiency in petroleum with the initial port delivery of crude oil through the trans-Andean oil pipeline in mid-1977. Increased output from oil wells in the Amazon basin more than compensated for the declining trend in output from the northwest coast fields and the continental shelf.

Some labor unrest continued in 1977. According to the records of the Peruvian Mining Society, 16 strikes occurred resulting in a loss of 633,000 worker-hours compared with 29 strikes in 1976 resulting in loss of 575,000 worker-hours. Strikes were motivated by requests for pay increases and mainly for reemployment of mining personnel discharged under Decree-Law 21462 of April 1976 which declared the Peruvian mining industry in a "state of emergency" and authorized mining companies to dismiss personnel involved in work stoppages declared illegal. Approximately 77,000 persons were employed in the mining industry: 27,000 in the large scale mining sector, 40,000 in the medium sector and 10,000 in the small sector.

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Table 1.—Peru: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Antimony:			
Mine output, metal content	122	603	823
Metal	107	339	504
Arsenic, white	1,260	797	1,367
Bismuth:			
Mine output, metal content	505	521	585
Metal	500	456	516
Cadmium:			
Mine output, metal content	503	360	380
Metal	160	174	182
Copper:			
Mine output, metal content	165,813	200,788	324,988
Copper sulfate	1,104	4,422	e5,620
Metal:			
Smelter	156,610	184,549	306,259
Refined	71,476	140,116	187,183
Gold:			
Mine output, metal content, troy ounces	100,799	80,730	96,227
Metal, do	71,476	74,204	89,315
Indium metal, kilograms	1,587	3,270	3,734
Iron and steel:			
Iron ore and concentrate, thousand tons	7,753	4,776	6,284
Pig iron, do	286	232	244
Ferroalloys	895	320	e500
Steel, ingots and castings, thousand tons	432	349	379
Lead:			
Mine output, metal content	r154,168	159,758	166,068
Metal	71,142	74,121	79,385
Manganese:			
Ore and concentrate, gross weight	2,045	613	--
Metal content	740	164	--
Mercury, 76-pound flasks	1,530	--	--
Molybdenum, mine output, metal content	443	453	463
Selenium metal, refined, kilograms	6,681	8,754	15,920
Silver:			
Mine output, metal content, thousand troy ounces	34,027	35,579	38,063
Metal, do	r18,561	19,452	22,145
Tellurium metal, kilograms	21,166	12,306	18,333
Tin, mine output, metal content	255	273	366
Tungsten, mine output, metal content	625	591	526
Zinc:			
Mine output, metal content	364,915	421,310	405,384
Metal	63,241	64,680	68,541
NONMETALS			
Barite	331,700	330,689	434,984
Cement, hydraulic, thousand tons	1,950	1,966	1,970
Chalk	361,615	NA	NA
Clays:			
Bentonite	39,545	e40,000	41,545
Fire	10,743	19,085	19,500
Kaolin	9,516	9,116	10,600
Common	371,443	328,811	380,500
Diatomite	17,239	e18,000	18,800
Feldspar	3,905	e4,000	4,320
Fertilizer materials:			
Crude: Phosphate, guano	--	2	--
Manufactured, nitrogenous	47,785	100,289	117,795
Graphite	59	60	60
Gypsum, crude	210,543	171,726	215,100
Mica	2	e10	e10
Salt, all types	304,216	r e305,000	310,440
Stone, sand and gravel:			
Dimension stone:			
Marble	3,204	NA	(1)
Slate	665	NA	700
Crushed and broken stone:			
Dolomite	23,662	e24,500	25,450
Limestone, thousand tons	3,166	3,144	3,550
Quartz and quartzite	3,681	6,955	e7,050
Silica, thousand tons	261	e300	300
Sand and gravel, do	4,439	4,052	4,481
Sulfur:			
Elemental:			
Native	593	e600	600
Byproduct of metallurgy	15,900	16,300	20,000
Sulfuric acid and oleum, gross weight	48,580	45,297	48,606
Talc and related materials:			
Talc	2,682	13,562	2,710
Pyrophyllite	11,182		11,850

See footnotes at end of table.

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Table 1.—Peru: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	--	2,130	5,698
Coal:			
Anthracite	22,929	10,816	23,410
Bituminous[e]	--	r(3)	(3)
Coke, all types[e]	12,000	10,000	10,000
Gas, natural:			
Gross production, million cubic feet	64,959	71,597	72,763
Marketed, do.	29,398	e32,500	e32,900
Natural gas liquids:			
Natural gasoline and other[4], thousand 42-gallon barrels	510	508	493
Propane, do.	125	79	74
Butane, do.	5	7	8
Total, do.	640	594	575
Petroleum:			
Crude, do.	26,294	27,936	33,276
Refinery products:			
Aviation gasoline, do.	1	1	(3)
Motor gasoline, do.	12,995	12,336	11,981
Jet fuel, do.	1,844	1,628	1,325
Kerosine, do.	4,696	4,990	5,017
Distillate fuel oil, do.	7,271	7,710	7,304
Residual fuel oil, do.	12,786	13,194	15,448
Lubricants, do.	87	108	63
Other:			
Liquefied petroleum gas, do.	1,202	1,091	1,220
Asphalt, do.	230	296	246
Unspecified, do.	208	150	217
Refinery fuel and losses, do.	317	488	505
Total, do.	41,637	41,992	43,326

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.
[1]Included with "Quartz and quartzite."
[2]Includes marble.
[3]Less than 1/2 unit.
[4]Includes hexane.

Table 2.— Peru: Centromin Peru production of refined metals and sub products

Commodity	1975	1976	1977	Change (percent) 1976-77
Refined metals:				
Copper, metric tons	23,647	35,459	41,772	+18
Lead, do.	70,966	74,066	79,243	+7
Zinc, do.	61,975	64,382	66,949	+4
Silver, troy ounces	17,861,266	19,227,701	21,572,316	+12
Gold, do.	31,046	r34,691	36,362	+5
Bismuth, metric tons	500	456	516	+13
Cadmium, do.	160	174	182	+5
Indium, kilograms	1,447	3,271	3,734	+14
Selenium, do.	6,681	r8,743	15,920	+82
Tellurium, do.	21,166	r12,306	18,333	+49
Metals in blister copper for export:				
Copper content, metric tons	12,764	5,525	1,486	-73
Silver content, troy ounces	2,629,652	r1,230,536	303,535	-75
Gold content, do.	6,497	r2,215	579	-74
Sub products and alloys (metric tons):				
Zamac (zinc alloy)	1,267	161	--	XX
Antimony, crude	171	r315	496	+57
Antimonial lead	253	r20	8	-60
Arsenic trioxide	1,283	r789	1,367	+73
Copper sulfate	4,736	r1,031	1,311	+27
Zinc sulfate	1,785	r635	705	+11
Zinc powder	398	r1,517	1,592	+5
Sulfuric acid	48,580	r45,279	48,606	+7
Tungsten concentrate (WO_3):				
Morococha	NA	72	77	+7
Mahr Tunnel, metric tons	NA	376	369	-2

[r]Revised. NA Not available. XX Not applicable.

Source: Centromin Perú.

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TRADE

As a developing country in an early industrialization stage, Peru consumed a small part of its mineral production and exported about 97% of its copper, 96% of its silver, 96% of its zinc, 98% of its iron ore, and 95% of its lead. The upward trend in the value of Peru's mineral exports continued in 1977. Mineral exports were valued at $874 million in 1977, compared with $696 million for 1976 and $560 million for 1975, and represented 53% of the country's total export earnings. The Government reported the following data for 1977 for Peru's five leading mineral commodity exports.

Commodity	Quantity	Change (percent) 1976-77	Value f.o.b. (million dollars)	Change (percent) 1976-77	Share of total exports (percent)
Copper metric tons	311,300	+63	$363	+65	22
Silver thousand troy ounces	42,471	+7	172	+21	10
Zinc metric tons	398,700	-12	126	-19	8
Iron ore do	4,120,000	+40	85	+42	5
Lead do	162,700	-6	78	+56	5
Other mineral products	NA	NA	50	-17	3
Total minerals	NA	XX	874	+20	53
Total exports	XX	XX	1,666	+23	100

NA Not available. XX Not applicable.

The United States (17%) was the most important market in 1977 for Peruvian copper followed by Japan (13%), United Kingdom (9%), Latin America (9%), and Italy (8%).

About 76% of Peru's mineral exports are shipped as refined products and Peru expects to refine all of its ores and concentrates by the year 2000. In 1977 Peru had the capacity to refine 95% of its copper, 50% of its lead and zinc, and 3% of its iron ore.

Total imports by Peru in 1977 amounted to $2,164 million; about the same as in 1976. Imports of crude oil, valued at $190 million, continued as one of the leading items among mineral imports.

Table 3.—Peru: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal including alloys, semimanufactures	148	95	Bolivia 79; Ecuador 16.
Antimony:			
Ore and concentrate	817	579	Japan 352; Belgium-Luxembourg 183.
Metal including alloys, all forms	21	231	United States 115; Chile 69; Netherlands 28.
Arsenic trioxide, pentoxide, acids	250	50	All to Argentina.
Bismuth metal including alloys, all forms	220	641	United States 244; Netherlands 213; U.S.S.R. 100.
Cadmium metal including alloys, all forms	150	199	United States 76; Netherlands 75; Brazil 22.
Copper:			
Ore and concentrate	103,362	44,584	Japan 21,597; United States 9,197; Spain 4,989.
Matte	384	1,846	Spain 1,253; Netherlands 593.
Copper sulfate	86	144	Venezuela 60; Colombia 51; West Germany 22.
Metal including alloys:			
Unwrought:			
Blister	122,160	170,207	United Kingdom 39,002; United States 31,794; People's Republic of China 22,998; Belgium-Luxembourg 20,039.
Refined	36	37	Mainly to Venezuela.
Masteralloys	--	10	All to Venezuela.
Semimanufactures	4,791	2,750	Ecuador 927; El Salvador 707; Colombia 401.

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Table 3.—Peru: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Gold metal, content of mixed bars—troy ounces	--	65	United Kingdom 42; Venezuela 12; United States 11.
Iron and steel:			
Ore and concentrate (except roasted pyrite) thousand tons	5,332	4,303	Japan 2,392; United States 701.
Metal:			
Pig iron, including cast iron	--	30	All to Bolivia.
Semimanufactures	1,625	1,512	Bolivia 849; Chile 334; Ecuador 184.
Lead:			
Ore and concentrate	118,079	162,983	Japan 52,770; Belgium-Luxembourg 47,812; United States 47,561.
Oxides	621	873	Colombia 379; Venezuela 361.
Metal:			
Scrap	65	68	All to Ecuador.
Unwrought	63,994	85,431	United States 20,855; Italy 19,519; People's Republic of China 12,996; U.S.S.R. 9,484.
Semimanufactures	28	31	All to Ecuador.
Manganese metal	--	1	All to United States.
Mercury 76-pound flasks	1,011	--	
Molybdenum ore and concentrate	1,014	814	Netherlands 551; U.S.S.R. 193.
Platinum-group metals troy ounces	--	289	All to West Germany.
Selenium, elemental	3	7	Italy 3; Brazil 1; Mexico 1; United States 1.
Silver:			
Ore and concentrate	1,121	--	
Metal including alloys thousand troy ounces	18,196	21,526	United States 10,448; Japan 6,191.
Tellurium, elemental	29	26	United States 21; Netherlands 5.
Tin:			
Ore and concentrate	703	759	All to United Kingdom.
Metal including alloys, all forms	11	37	Ecuador 22; Costa Rica 6; Honduras 5.
Tungsten ore and concentrate	1,483	1,137	United States 536; Japan 357; U.S.S.R. 201.
Zinc:			
Ore and concentrate	647,621	665,883	Japan 297,895; Italy 65,782.
Oxide	300	382	Colombia 192; Ecuador 174.
Metal including alloys, all forms	64,141	76,144	United States 18,924; Brazil 17,439; Italy 8,240.
Other:			
Ash and residue containing nonferrous metals	10,544	--	
Oxides, hydroxides, peroxides of metals, n.e.s	2	250	Brazil 227.
Metals including alloys, all forms, n.e.s	(1)	5	West Germany 2; United States 2.
NONMETALS			
Abrasives: Pumice, emery, natural corundum, etc	--	1	Mainly to Japan.
Barite and witherite	357,477	367,075	United States 220,259; Netherlands 88,345; Trinidad and Tobago 47,264.
Boron, crude natural borates	589	2,715	Colombia 1,025; Brazil 815; Mexico 774.
Cement, hydraulic	1,255	2,217	All to Ecuador.
Chalk	--	170	Ecuador 150; Bolivia 20.
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite	836	897	Colombia 804; Ecuador 93.
Kaolin	52	--	
Products	74	355	Bolivia 184; Ecuador 171.
Fertilizer materials, manufactured	25	67	Ecuador 35; Bolivia 32.
Gypsum and plasters	--	77	All to Ecuador.
Lime	350	1,024	Do.
Precious and semiprecious stones	1	(1)	Mainly to United States.
Salt and brines	--	185	All to Ecuador.
Stone and sand and gravel:			
Dimension stone, crude and partly worked	278	349	Colombia 215; Venezuela 70; Spain 64.
Quartz and quartzite	(1)	--	
Sulfur:			
Elemental, other than colloidal	--	2	All to Bolivia.
Sulfuric acid	65	--	
Talc	3	--	

See footnotes at end of table.

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Table 3.—Peru: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
MINERAL FUELS AND RELATED MATERIALS			
Coal and briquets	10	--	
Petroleum:			
Crude thousand 42-gallon barrels	1,482	2,738	Brazil 2,602; Argentina 135.
Refinery products:			
Gasoline do	6	3	All to Ecuador.
Residual fuel oil do	502	247	NA.
Lubricants do	99	68	NA.
Other:			
Liquefied petroleum gas do	96	15	All to Ecuador.
Unspecified do	1	(1)	Do.
Total do	704	333	

NA Not available.
[1]Less than 1/2 unit.

Table 4.—Peru: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite and concentrate	2,373	2,229	United States 1,886; Guyana 343.
Oxide and hydroxide	3,838	1,434	West Germany 923; United States 281; Brazil 211.
Metal including alloys, all forms:			
Scrap	4	--	
Unwrought	7,095	3,716	Venezuela 3,201; Canada 430.
Semimanufactures	2,879	2,536	United States 708; Italy 498; West Germany 421.
Antimony metal including alloys, all forms	2	--	
Arsenic:			
Natural sulfides	(1)	--	
Trioxide, pentoxide, acids	5	(1)	All from West Germany.
Chromium:			
Ore and concentrate	3,078	1,066	Mainly from United States.
Oxide and hydroxide	51	34	West Germany 26; Spain 3; United Kingdom 3.
Metal including alloys, all forms kilograms	4,930	--	
Cobalt oxide and hydroxide	1	(1)	All from United States.
Copper:			
Ore and concentrate	645	--	
Copper sulfate	1	2	Italy 1.
Metal including alloys:			
Unwrought	14	4	Denmark 1; West Germany 1; United Kingdom 1; United States 1.
Semimanufactures	1,072	--	
Gold metal, unworked or partly worked troy ounces	97	--	
Iron and steel:			
Ore and concentrate	29	22	United States 19; Switzerland 3.
Metal:			
Scrap	62,950	22,061	All from United States.
Pig iron, ferroalloys, similar materials	11,703	749	Republic of South Africa 481; West Germany 128.
Steel primary forms	9,679	1,625	United States 1,587.
Semimanufactures:			
Bars, rods, angles, shapes, sections	45,131	23,862	Japan 11,460; United States 4,535; Poland 2,621.
Universals, plates, sheets	95,358	66,792	Japan 29,467; United States 11,815; France 11,258; Canada 8,687.
Hoop and strip	3,922	3,125	Japan 1,936; United States 563; West Germany 467.
Rails and accessories	10,239	4,042	United Kingdom 3,130; West Germany 433.
Wire (excluding wire rod)	5,524	3,776	Japan 1,986; Belgium-Luxembourg 557; West Germany 467.
Tubes, pipes, fittings	104,855	38,296	United States 14,897; West Germany 10,404; Japan 8,855.
Castings and forgings, rough	9,835	5,279	United States 3,816; Chile 548.

See footnotes at end of table.

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Table 4.—Peru: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Lead:			
Oxides	1	20	All from Taiwan.
Metal including alloys, all forms	12	(1)	Mainly from West Germany and Brazil.
Magnesium metal including alloys, all forms	8	10	United States 9; West Germany 1.
Manganese:			
Ore and concentrate	4	--	
Oxide	2,170	1,527	United States 817; Japan 426; Belgium-Luxembourg 159.
Mercury 76-pound flasks	3	270	Mainly from United States.
Nickel:			
Matte, speiss, similar materials	1	--	
Metal including alloys, all forms	129	3	Mainly from United States.
Platinum-group metals and silver: metal, including alloys:			
Platinum-group troy ounces	1,443	55	All from United States.
Silver do	1,125	1,157	NA.
Rare-earth metals:			
Oxides	11	6	Mainly from France.
Metals including alloys kilograms	328	--	
Tin:			
Oxides	(1)	1	Mainly from Mexico and Italy.
Metal including alloys, all forms	276	230	Mainly from Bolivia.
Titanium oxide	2,406	247	West Germany 67; Mexico 40; United States 35; Belgium-Luxembourg 32; Italy 29.
Tungsten metal including alloys, all forms	3	8	Mainly from United States.
Zinc:			
Oxides	13	5	All from West Germany.
Metal including alloys, all forms	87	115	United States 92; Japan 18.
Other:			
Ores and concentrates, n.e.s	115	92	All from Australia.
Oxides, hydroxides, peroxides of metals, n.e.s	145	66	West Germany 36; United States 19; Chile 8.
Metals including alloys, all forms	11	29	Italy 18; United Kingdom 6; Belgium-Luxembourg 4.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	106	108	United States 71; Netherlands 16; West Germany 15.
Grinding and polishing wheels and stones	122	78	West Germany 21; Spain 18; Mexico 9; Italy 8; United States 8.
Asbestos	17,238	7,329	Canada 4,931; U.S.S.R. 886.
Barite and witherite	286	16	United States 10; Mexico 6.
Boron materials:			
Crude natural borates	1	--	
Oxide and acid	151	101	United States 79; United Kingdom 11; West Germany 10.
Cement	4,429	82,684	Colombia 75,885.
Chalk	226	10	All from France.
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite	3,006	850	Mainly from United States.
Kaolin	4,107	1,028	United States 919; United Kingdom 107.
Other	2,357	987	United States 376; France 338; Japan 148.
Products	9,682	7,340	Italy 3,200; United States 1,350; Canada 790.
Cryolite and chiolite	2	--	
Diamond, all grades value, thousands	$1,126	$82	Mainly from Belgium-Luxembourg.
Diatomite	2,091	1,357	Mexico 1,100; United States 233.
Feldspar and fluorspar	1,460	2,085	Argentina 1,020; Mexico 941.
Fertilizer materials, manufactured:			
Nitrogenous	102,520	57,231	Romania 19,157; United States 15,254; Bulgaria 10,564; West Germany 5,685.
Phosphatic	26,221	--	
Potassic	11	15,108	Canada 10,500; United States 4,557.
Mixed	30,869	209	United States 167; West Germany 32.
Graphite, natural	45	39	West Germany 20; Japan 9; France 8.
Gypsum and plasters	604	703	All from United States.
Magnesite	2,735	19	West Germany 9; United States 8; Austria 2.
Mica:			
Crude, including splittings and waste	98	73	United States 62; Norway 8.
Worked, including agglomerated splittings	8	5	West Germany 2; Spain 1; Switzerland 1; United States.
Pigments, mineral, including processed iron oxides	783	406	West Germany 336.
Precious and semiprecious stones, except diamond value	$4,274	$3,503	All from West Germany.

See footnotes at end of table.

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Table 4.—Peru: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Salt	212	258	United States 152; United Kingdom 93.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	17,165	186	Italy 139; United States 35.
Caustic potash, sodic and potassic peroxides	72	107	West Germany 96.
Soda ash	39,177	25,156	United States 23,351.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	963	836	Mainly from Italy.
Worked	62	69	Do.
Dolomite	2,603	--	
Gravel and crushed rock	--	3	All from Belgium-Luxembourg.
Quartz and quartzite	61	27	Mexico 14; West Germany 7; Belgium-Luxembourg 5.
Sand, excluding metal bearing	2,255	4,553	United States 4,320.
Sulfur:			
Elemental:			
Other than colloidal	3,793	4,333	Mainly from United States.
Colloidal	256	4	West Germany 2; United States 2.
Sulfur dioxide	45	--	
Sulfuric acid	1	1	Mainly from United States and Switzerland.
Other nonmetals:			
Slag, dross, and similar waste, not metal-bearing	330	33	All from United States.
Oxides and hydroxides of magnesium, strontium, barium	636	125	Mexico 35; United States 31; Colombia 21; Italy 18.
Bromine, iodine, fluorine	4	3	France 2; Chile 1.
Building materials of asphalt, asbestos and fiber cement, and unfired nonmetals, n.e.s	175	25	Mainly from United States.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	70	279	Do.
Carbon black and gas carbon	3,565	2,836	Colombia 2,486.
Coal and briquets:			
Anthracite and bituminous coal	46,851	20,078	All from United States.
Lignite and lignite briquets	258	90	Do.
Coke and semicoke	233,052	84,084	Japan 61,694; West Germany 20,994.
Gas, hydrocarbon	14,171	5,772	Venezuela 3,353; Chile 2,394.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	16,586	20,780	Ecuador 14,556; Venezuela 5,240.
Refinery products:			
Gasoline:			
Aviation do	436	280	Chile 158; Venezuela 75; Netherlands Antilles 41.
Motor do	87	54	Netherlands 14; Venezuela 14. United States 13; Brazil 12.
Kerosine do	158	132	Bahamas 120; United States 12.
Jet fuel do	373	860	Venezuela 437; United States 325.
Distillate fuel oil do	1,139	964	Venezuela 426; Netherland Antilles 332; Brazil 109; United States 96.
Residual fuel oil do	759	51	Mainly from Bahamas.
Lubricants do	468	402	Netherlands Antilles 204; United States 106; Venezuela 87.
Mineral jelly and wax do	151	40	Taiwan 24; West Germany 13.
Other:			
Nonlubricating oils, n.e.s do	8	4	United States 2; Netherlands 1.
Pitch do	1	(1)	Mainly from United Kingdom and West Germany.
Bituminous mixtures, n.e.s do	1	(1)	Mainly from United States.
Unspecified do	(1)	(1)	All from United States.
Total do	3,581	2,787	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	1,193	902	Netherlands Antilles 378; United States 351; United Kingdom 121.

NA Not available.
[1]Less than 1/2 unit.

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COMMODITY REVIEW

METALS

Copper.—In 1977 Peru ranked seventh as a world producer of copper and contributed 4.2% of total world production. During 1977 there were significant increases in all major copper products: Refined copper, blister copper, and ores and concentrates—but especially blister copper, which increased 66%. This was the first full year in which the Ilo smelter handled the combined output of the Toquepala and Cuajone copper mines.

The increase in copper production was primarily due to the new output from the Cuajone mine of Southern Peru Copper Corp. (SPCC) that contributed its first full year of operation, the startup of the Cerro Verde-Stage I mine of Minero Perú and the expansion of the Raul mine, about 91 kilometers south of Lima, owned by Cia. Minera Pativilca S.A.

The inauguration of Cerro Verde-Stage I in mid-1977 represented the first mine to be placed in operation by Minero Perú since its assignment by the Government in 1970. The $198 million project to exploit Cerro Verde's copper oxide ores was expected to eventually produce 33,000 tons of fine copper per year. However, during the initial year, 8,750 tons of copper cathodes was produced, and 25,000 tons was projected by 1978. Minero Perú continued planning of Cerro-Verde-Stage II for developing 1.2 billion tons of copper sulfide ore with an average grade of 0.64% copper. Five companies from Canada, Japan, and Italy presented proposals for constructing Phase I of Cerro Verde II, on a turnkey basis, to produce 60,000 tons of contained copper in concentrate.

As operator of the two largest copper mines in Peru, Toquepala and Cuajone, SPCC produced 74% of Peru's total mine copper output. At Toquepala, 98,300 tons of blister copper was produced from mill grade of 0.91%; at Caujone, 159,450 tons of blister copper was produced from mill grade ore of 1.41%. SPCC employed 6,300 workers during 1977, an increase of 15%. SPCC's net sales during 1977 of $268 million were to Minero Perú Comercial (MINPECO)—42%, ASARCO Incorporated—12%, Billiton Metallurgie B.V.—11%, a Japanese group—10%, Marmon Group—5%, Phelps Dodge Refining Corp.—4%, and the Newmont Mining Corp.—2%.

Centromin Perú was Peru's second largest copper producer at 56,520 tons representing 17% of Peru's total mine output. Centromin Perú refined all of its blister production. In 1977, Centromin Perú reached a record high in output of refined copper of 41,772 tons, an increase of 18% at its metallurgical complex at La Oroya and continued planning to expand the capacity of the copper refinery from 58,000 tons per year to 73,000 tons per year. Centromin Perú obtained financing from the Inter-American Development Bank and the World Bank for its $161 million project to expand the copper mine and concentrator of Cobriza. Mine output at Cobriza is to be increased from 2,500 tons per day to 10,000 tons per day. An annual production of 203,000 tons of concentrate containing 26% copper is expected in March 1980 when the work is scheduled for completion. In March 1977, Centromin Perú entered into an agreement with Arthur McKee Inc. and Motlima del Peru for management services. By yearend, the basic engineering studies for Cobriza were almost completed, 1,600 meters of the total 5,000 meters of tunneling was completed, and construction was initiated on the 14-kilometer access road.

The new Aquila mine, owned by Mines Aquila S.A. and located at Huaraz in Sihuas Province, was scheduled to come on-stream in March 1978 with an annual production of 2,200 tons of copper. Concentrate from the mine was to be mixed with water, pumped across the continental divide, and trucked 100 miles to the port of Chimbote. The Aquila mine has measured and indicated reserves of 22 million tons of 1.4% copper, with inferred reserves of 45 million tons.

Table 5 provides a summary of the major copper deposits being planned for development by Minero Perú and Centromin Perú.

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Table 5.—Peru: Large copper deposits planned for development

Deposit	Location	Owner	Reserves (million metric tons)	Ore grade (percent sulfides)	Cost (million dollars)	Annual production (metric tons)	Start-up date
Cerro Verde II-Phase I	Arequipa	Minero Perú	1,200	.64	250	60,000	1981
Tintaya	Espinar, Cuzco	do.	[1]50	2.0	182	50,000	1982
Michiquillay	Cajamarca	do.	544	.69	595	92,000	1985
Antamina	Huari, Ancash	do.	[2]100	2.6	590	89,200	1985
Quellaveco	Mariscal Nieto, Moquequa	do.	380	.85	300	65,000	1986
Toromocho	Morococha, Lima	Centromin Perú	400	.75	[3]1,200	83,600	1988

[1]In addition, Tintaya has 10 million tons of oxide ore with 2.2 copper.
[2]Ore also contains 3.1 zinc providing the basis for annual production of 66,200 tons of zinc, 1,490 tons of molybdenum concentrate, and 33.6 tons of silver.
[3]This estimated cost includes a smelter and refinery, necessary due to the antimony and arsenic content of the ore. However, the company is studying the possibility of developing this deposit in a first stage, at a capacity of 15,000 dry short tons per day, treating concentrates at the La Oroya smelter and refinery. Required investment for this first stage would be $190 million and the project would be in production by 1982.

The Ilo copper refinery, located on the Pacific coast west of the Toquepala and Cuajone mines, operated throughout 1977 and produced 123,400 tons of copper cathodes. In connection with expansion of the Ilo refinery from 150,000 to 300,000 tons per year, Minero Perú reached agreement with Mitsui Furukawa of Japan for the tankhouse and hospital, and with Maerz Ofenbau of Switzerland for the anode plant. Minero Perú was awaiting Government authorization to sign the contract.

Gold.—The Government was considering a draft law to encourage investment in gold mining in response to the surge in the gold price and possibilities of improving Peru's foreign exchange position. Several gold placer deposits in southeastern Peru were attracting interest. Minero Perú invited the domestic and foreign private sectors to participate in the exploitation of a well-known gold placer deposit called San Antonio de Poto in the Department of Puno. This deposit, worked by Natomas Co. of California between 1961 and 1972, has long been regarded as a promising prospect for increased gold production. Centromin Perú initiated extensive exploration in the same area. In 1977, the Banco Minero discovered a large gold placer deposit in the Alto Laberinto area on the left bank of the Madre de Dios River, about 65 kilometers west of Puerto Maldonado in southeastern Peru and another placer deposit at Huaypetue in the same Department.

The major part of Peru's current gold production came from placer deposits in streams on the eastern slopes of the Andes Mountains. Centromin Perú continued as Peru's largest gold producer from the metallurgical complex at La Oroya. Centromin Perú's gold output in 1977 in gold bars, concentrates, and blister copper was 36,941 troy ounces, respresenting 41% of Peru's total gold output. The Banco Minero purchased 38,260 troy ounces of gold from individual gold workers in the jungle, a 35% increase over the 1976 level. Minas Ocoña S.A., previously known as Andaray Gold Mines, operated the only lode gold mine in the Department of Arequipa. In operation for over 50 years, Minas Ocoña produces about 14,150 troy ounces each year.

Peru exported about 128,600 troy ounces of gold in 1977 valued at $18.5 million. The United States (40%) was the major importer, followed by the United Kingdom (24%), Switzerland (19%), and Venezuela (17%).

Iron Ore.— Hierro Perú, the only iron ore producer, achieved a strong rebound in output from its Marcona deposit in 1977 compared with the depressed level of 1976. The various forms of ore produced are given in the following tabulation, in metric tons. Exports of iron ore went mostly to Japan, the United States, and Korea.

	1976	1977
Iron ore pellets	2,339,340	2,531,570
Sinter feed	1,441,870	2,416,790
Pellet feed:		
Cake	501,950	508,290
Slurry	493,140	733,830
Total	4,776,300	6,190,480

Lead and Zinc.—Centromin Perú continued as Peru's major lead and zinc producer accounting for 48% and 47%, respectively, of the country's total. Thirteen other impor-

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tant lead and zinc producers in 1977 are shown in Table 6. Centromin Perú proceeded with its $78 million project to rehabilitate and expand the zinc circuit at La Oroya from 70,000 to 90,000 tons per year. By yearend, 90% of the basic engineering and 30% of the detailed engineering had been completed.

Minero Perú's contract with Syndicat Belge d'Enterprise S.A. "SYBETRA" for construction of the new zinc refinery at Cajamarquilla, 35 kilometers east of port Callao, in Lima, became effective in August. During the year, construction was started on the railroad tunnel connecting Cajamarquilla with the main rail line. Foreign financing for the $203 million refinery was arranged as follows: SYBETRA-$60.4 million, Kreditanstalt für Wiederaufbau (KFW)-$36.4 million, Belgian Government-$4.1 million, Banco Exterior de España-$719,000, and suppliers's credits-$225,000.

Table 6.—Peru: Mine output of principal lead and zinc producers

(Metric tons of metal content)

Company	Lead		Zinc	
	1976	1977	1976	1977
Centromin Perú	64,412	79,300	198,399	188,720
Cia. Minera San Ignacio de Morococha	2,735	3,245	36,499	42,910
Cia. Minera Santa Luisa	10,399	11,112	24,389	29,556
Cie des Mines de Huaron S.A	10,366	9,725	25,708	25,600
Volcan Mines Co.	884	805	16,087	20,247
Cia. Minera Atacocha	15,976	16,614	18,266	19,190
Cia. Minera Milpo	10,751	9,485	17,200	17,780
Cia. de Minerales Santander	1,345	1,021	20,138	17,300
Cia. Minera Raura	10,345	9,485	11,606	12,480
Cia. Minera del Madrigal	5,050	6,052	9,430	10,575
Minas de Gran Bretaña	--	--	9,522	9,564
Cia. Minera Rio Pallanga	5,071	5,380	6,056	6,635
Cia. Minera Alianza S.A	4,302	6,215	3,754	5,985
Cia de Minas de Buenaventura S.A	5,930	6,020	2,976	3,270

Manganese.—Minas de Gran Bretaña, Peru's only manganese producer (and an important zinc producer), discontinued the production of manganese in 1976 with 613 tons of ore containing 27% manganese.

Molybdenum.—SPCC produced the major part of Peru's molybdenum concentrate as a byproduct of its copper operations at Toquepala. The remainder of Peru's output came primarily from Cia. Minera Turmalin a, which operated a small mine in Piura in northern Peru. In 1977, SPCC produced 861 tons of molybdenum concentrate, a 16% increase, with a MoS_2 content of 88%. Peru's output of molybdenite was expected to increase by 3,200 tons when SPCC receives authorization to install an annex to its Botiflaca concentrator at the Cuajone mine.

Silver.—In 1977, silver replaced zinc as Peru's second most important export in value, after copper. Peru ranked fifth as a world silver producer. Centromin Perú continued as Peru's leading silver producer at La Oroya, chiefly as a byproduct of its copper-lead-zinc operations. Cia. de Minas de Buenaventura S.A. was Peru's second largest silver producer, with an output of 410;000 troy ounces, mostly from its Orcopampa lead mine in the Department of Arequipa. Other important silver producers were Minas de Arcata S.A., Cia. des Mines de Huaron S.A., Cia. Minera Alianza, S.A., Cia. Minera Castrovirreyna S.A., and Northern Peru Mining Corp. Silver exports in 1977 totaled 42.5 million troy ounces, a 7% increase compared with the 1976 level. More than 50% of Peru's silver was imported by the United States, followed by Japan, the Netherlands, and Sweden.

Tungsten.—There were three tungsten producers in Peru. Production, in tons of WO_3, is given in the following tabulation:

Company	1976	1977
Centromin Perú	447.2	447.0
Malaga Santolalla	212.0	213.0
Turmalina	19.6	36.7
Total	678.8	696.7

Centromin Perú recovered tungsten from its Morococha and Mahr Tunnel units in central Peru, Neg. Minera Malaga Santolalla e Hijos from the old Pasto Bueno mine in Ancash Department, and Cia. Minera Turmalina from an operation in northern Peru.

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NONMETALS

Barite.—Peru ranked third among the world's barite producers, behind the United States and the Soviet Union. Much of the production is destined for the gulf coast drilling mud market. Peru's major barite producer was Perubar S.A., a wholly owned subsidiary of NL Industries' Baroid Division. Perubar's Graciela mine in Huarochiri Province, east of Lima, has a current capacity of 300,000 tons per year of crude ore. A second producer, Minera Baribent S.A., produced 35,000 tons per year from its open pit operations in Junín. Drilling mud grade barite was also produced by Barmine S.A. from deposits in Huarochiri Province with a capacity of 50,000 tons per year. Filler and chemical grades of barite were produced at the Lima plant of Cia. Minera Agregados Calcareos S.A.

Cement.—Fuller Co. was contracted by Cementos del Norte Pacasmayo S.A. in Lima for equipment to increase production of its dry-process cement plant at Pacasmayo, located north of Trujillo. Capacity is to be increased from 1,000 to 3,000 tons per day with completion scheduled for the end of 1977.

Fertilizer Materials.—Pursuant to the "basis agreement" (acuerdo de bases) signed in December 1976, Empresa Nacional Adaro de Investigaciones Mineras S.A. (ENADIMSA) of Spain completed in 1977 the prefeasibility study to develop the Bayóvar phosphate deposit in northern Peru. Minero Perú expects to develop this deposit with private sector participation through a special mining company. The fertilizer petrochemical complex at Talara produced 118,000 tons of urea, representing 85% of its projected production for the year. Petroperú was studying the feasibility of constructing an ammonia-urea complex at Bayóvar.

Gypsum.—Cia. Minera Agregados Calcareos S.A., principally a cement producer, also mined a small amount of gypsum.

MINERAL FUELS

Coal.—During 1977, the combine of KOPEX of Poland and Universal Engineering of Switzerland was nearing completion of the Alto Chicama feasibility study to be delivered to Minero Perú in April 1978. The Alto Chicama coal project located in the Department of La Libertad is designed to generate electric power for the areas of Trujillo and Chimbote north of Lima on the Pacific coast. Minero Perú contracted with Boyles Bros. for a diamond drilling program to determine the extension of the coal seams. The results obtained indicate larger reserves of anthracite coal than the 60 million tons previously estimated.

In central Peru, Centromin Perú was involved in exploration of the Jatunhuasi coal deposit located in the region of La Oroya, 45 kilometers northwest of Huancayo. Preliminary results indicate the availability of high-grade bituminous coal. Centromin Perú was seeking coal of coking quality. The Jatunhuasi coal deposit was being explored under Special Rights, which is a program that reserved exclusively for development by the State.

Natural Gas.—Natural gas plays a small part in Peru's total energy situation, supplying about 4% of total energy demand. As in the case of crude oil, output of natural gas over the past decade has been nearly level after a peak of 77.1 billion cubic feet in 1969. In 1977, production of natural gas from the northwestern coastal field continued its descending trend, declining 6% to 32.3 billion cubic feet; however, output from the northern continental shelf continued its ascending trend, increasing 9% to 40.5 billion cubic feet. Almost half of the gas is liberated to the atmosphere.

Peru has a major gas field with estimated reserves of 530 billion cubic feet located in Aguaytia in the central Amazon jungle about 440 kilometers northeast of Lima and 39 kilometers west of Pucallpa. Petroperú's plans to revive the Aguaytia gas project is pending availability of financial resources. Peru's total gas reserves were estimated at 1.3 trillion cubic feet.

Petroleum.—The major petroleum event in 1977 was the arrival in May of crude oil at the Bayóvar terminal in northern Peru through the 853-kilometer trans-Andean oil pipeline completed in December 1976. The availability of crude oil on the Pacific coast made it possible for Peru by yearend to reduce imports of crude from 50,000 to 10,000 barrels per day. As a consequence, total imports of crude from Ecuador and Venezuela decreased 14% to 14.6 million barrels in 1977.

The startup of the pipeline also made it possible for Occidental Petroleum Corp. to barge its production from the Shiviyacu area down the Pastaza and Marañon Rivers to the jungle terminus of the pipeline at San Jose de Saramuro instead of shipping it to Brazil via the Amazon River. As a result, Peru's exports of crude oil to Brazil declined

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sharply in 1977 to meet domestic demand. After 15 years of importing crude oil, Peru was expected to become self-sufficient during 1978 and to have a surplus to resume significant exports.

Construcciones Protexa S.A. of Mexico continued building the 253-kilometer northern spur pipeline connecting Occidental's oilfields in the Shiviyacu area near the Ecuadorean border to the trans-Andean pipeline.

After a decade when output was practically constant, production of crude petroleum in 1977 reached a historic high, 91,200 barrels per day, compared with 76,500 barrels per day in 1976. During 1978, output was expected to reach 175,000 barrels per day. Domestic consumption of crude oil in 1977 was estimated at 116,000 barrels per day, requiring a reduced level of imports.

As detailed in table 7, Peru's improved petroleum situation was due to the 154% increase in output from the jungle areas where a Government-owned company and Occidental were operating. Petroperú's output from its Trompeteros oilfield in the Amazon basin increased from 1.1 million barrels in 1976 to 6.5 million barrels in 1977; in the Shiviyacu area, Occidental increased oil output from 2.7 million barrels to 3.8 million barrels in the same period. Occidental's production was limited by storage capacity since the northern spur line connecting the Occidental oilfields with Station No. 5 of the trans-Andean pipeline near Borja was still under construction. When the spur line is completed in early 1978, Occidental is expected to raise its level of oil production by opening up the oilfields of Forestal, Capahuari Norte, Capahuari Sur, Huayuri and Tambo, all located around Shiviyacu. Occidental expected to produce over 80,000 barrels per day from these fields by the end of 1978.

Petroperú contracted Geopet Asociados S.R. Ltda., the first 100% Peruvian company involved in petroleum drilling, to drill seven development wells in the Maquia oilfield located in the central jungle area south of Pucallpa.

In May, the expansion of the La Pampilla oil refinery near Lima to 100,000 barrels per day was completed by Compagnie Française d' Études et de Construction (TECHNIP). Peru's new total refinery capacity of 168,000 barrels per day was expected to meet the country's fuel needs until 1982. The Pampilla expansion made it possible to shut down the 8,000-barrel-per-day Conchan refinery in June.

Fuel prices continued their ascending trend in 1977. The price of regular motor gasoline increased 50% to $0.93 per gallon and premium gasoline increased 38% to $1.36 per gallon. Prices of kerosine, diesel fuel, and residual fuel each increased about 30%.

Exploration activities decreased in 1977 due primarily to Petroperú's difficult financial condition. Petroperú drilled 8 exploratory wells compared with 14 in 1976 and 38 in 1975. In the Amazon basin, Occidental continued drilling in block 1-A, and by yearend had drilled a total of 44 wells, of which 39 were producers, in the 8 oilfields discovered to date.

In March, the Government published the terms to govern the new exploration/exploitation contracts for areas in the continental shelf and the jungle that were reopened in July 1976. In general, the new terms follow the 1970 Peruvian model; that is, the contractors are to be paid a percentage of the production and will cover all expenses during the exploration contract; but, contrary to the old Peruvian model, the production split is open to negotiation, depending on specific situations; contractors are not obliged to carry out the three phases (geologic and geophysical exploration, exploratory drilling, and production) of the contract; and all taxes are to be paid directly by the contractors. On the same date the Government issued specifications for secondary recovery operations in the northwestern area, which has been divided into two sections: (1) La Brea-Pariñas, where bidding was restricted to companies from the Latin American Free Trade Association (LAFTA) group, and (2) Lobitos/EL Alto/Los Organos, where there was no restriction. However, no new contracts were signed during the year, and very few companies demonstrated interest by the purchase of information from Petroperú.

At yearend, Peru's proven oil reserves were estimated at 750 million barrels. The total petroleum resource base is uncertain but falls within the range of 2 to 26 billion barrels.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Peruvian Soles (S/)to U.S. dollars at the 1977 average exchange rate of S/84.27 = US$1.00.

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Table 7.—Peru: Production and trade of crude oil

(Thousand 42-gallon barrels)

Area	1974	1975	1976	1977	Percent change 1976-77
Production:					
Northwest coast	13,277	12,851	11,978	11,940	(1)
Continental Shelf	13,894	10,449	11,672	10,434	-11
Amazon jungle	898	2,994	4,285	10,903	+154
Total[2]	28,069	26,294	27,936	33,276	+19
Imports	10,188	16,586	20,780	14,616	-14
Exports	--	1,482	2,738	586	-71

[1]Less than 1/2 unit.
[2]Data may not add to totals shown because of independent rounding.

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The Mineral Industry of the Philippines

By K. P. Wang[1]

The Philippine economy showed a slight improvement in 1977, growing at a rate of just over 6%. The trade deficit was reduced to roughly $765 million[2] in 1977 from $1.06 billion in 1976; favorable capital flows lowered the impact of this deficit. Inflation was about 8% in 1977. At current prices, the Philippine gross national product (GNP) reached about $20.7 billion in 1977, compared with $17.7 billion (revised) in 1976. In terms of constant 1972 prices, the GNP was $10.5 billion in 1977 and $9.8 billion in 1976.

The mineral output value of the Philippines at about $720 million represented only 3.5% of the 1977 GNP. Value added for refined materials and metals was not included in the output value, although this figure is generally small for the Philippines. However, minerals continued to be very important in overall trade, constituting 17% of all exports. Three-fourths of Philippine mineral production went to foreign markets. Mineral fuels (mainly oil) alone represented one-fourth of all imports in 1977, and base metals accounted for another 7%.

Improved performance by the mineral industry was tempered by the fact that inventories were building up in nickel and chrome. Copper prices were improving, however, and the Philippines started to have problems delivering concentrates to foreign buyers. Increased gold prices did not lead to increased primary production, but byproduct gold production from copper registered a significant gain. Copper earnings were expected to improve as a result of successfully renegotiated reduced smelting charges conceded by the Japanese smelters. Chromite prices started to stabilize at yearend.

Various copper facilities were being readied to resume operations in late 1977, such as the 30,000-ton-per-day mill of Western Minolco Corp. and the 15,000-ton-per-day mill at Ino owned by Consolidated Mines Inc.[3] A number of other copper projects were already partially completed, including a 10,000-ton-per-day mill in Negros Oriental Province, owned by Construction & Development Corp. of the Philippines; a 10,000-ton-per-day mill in Davao Province on Mindanao Island, owned by Sabena Mining Corp.; a 30,000-ton-per-day plant in Negros Occidental Province called the Hinobaan project, owned by Lepanto Consolidated Mining Co.; and a 17,000-ton-per-day one-mill complex in Zambales Province called the Dizon project, owned by Benguet Consolidated Inc. Some old gold projects were being reexamined because of improved gold prices, including the Masbate project of Atlas Consolidated Mining & Development Corp. and the Surigao project of Manila Mining Corp. Conditions were not favorable for finding additional large chromite deposits. New nickel ventures were not likely to be implemented because of the price and technical difficulties associated with this metal.

Atlas, the country's best known mining company with principal operations on Cebu Island, grossed $177.5 million but netted only $10.8 million in 1977, compared with $157.7 million gross and $25.4 million net profits in 1976.[4] Atlas produced over 80,000 troy ounces of gold and nearly 129,000 tons of mine copper, although its new 32,000-ton-per-day open pit called Carmen had just started full-scale operations during 1977.

Philex Mining Corp., with a block-caving porphyry mine in the Baguio area, registered the highest profitability among Philippine mining companies, with a net profit

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of $19 million derived from a $68.5 million gross revenue. Philex was the country's leading gold producer with 185,000 troy ounces in 1977 and the third largest copper producer with 33,567 tons of mine copper in 1977.

Benguet (mainly a gold producer) ranked fourth among Philippine mining companies in overall returns, with gross earnings of $66.9 million and a net income of $8 million in 1977 derived from over 100,000 troy ounces of gold output from mines in Baguio. This firm was entering the copper business with the Dizon project.

Marcopper Mining Corp., with mines in Marinduque Province, grossed $49.8 million in 1977 and cleared $6.6 million in profits. Marcopper was the country's second largest copper producer, with mine output of 47,236 tons in 1977, also producing 45,000 troy ounces of gold. Marcopper started to develop the San Antonio ore body under the tailings pond.

Lepanto grossed $35 million in 1977 and netted $4.65 million from its Mankayan mine near Baguio, which produced about 18,000 tons of mine copper and 75,000 troy ounces of gold. Lepanto was working on a roaster project to cut down on arsenic, and the smelter that treats its ore (ASARCO Incorporated's Tacoma smelter near Seattle) regained its operating permit.

Marinduque Mining & Industrial Corp., with copper mines at Sipalay (Negros Occidental Province) and Bagacay and nickel operations near Surigao, had a gross of $138 million in 1977 but incurred a loss of $11 million. The Sipalay mine made money but the nickel project more than lost it, forcing Marinduque to temporarily shut down Bagacay.

Consolidated Mines fared passably well with its chromite business. However, various small gold-copper companies incurred losses in 1977, especially Western Minolco but also Benguet Exploration Inc., Black Mountain Inc., and Itogon-Suyoc Mines Inc.

Certain developments affected all mining companies, whether primarily domestically capitalized or foreign investment oriented. Presidential Decree 1352 lifted the tax-free provisions for the importation of capital equipment for new mines granted under Presidential Decree 463 (Mineral Resources Development Decree of 1974); instead it imposed a 5% customs duty and a 5% internal revenue duty. However, Presidential Decree 1353, issued around the same time, allows accelerated deduction of exploration and development expenditures by mining companies, provided the amount does not exceed 25% of net income; this decree is the Government's reply to the mining industry's petition for an alternative to the percentage depletion allowance phased out starting in 1975.[5] The Government had not yet taken action on the pleas of the copper industry for tax and other relief, either on an individual firm or industry-wide basis.

Philippine Central Bank Circular No. 602 of early 1978 required all primary and secondary gold producers to sell their gold to the Bank for refining at its newly completed refinery. This decision produced uncertainty concerning pricing mechanisms, smelting and refining charges, and the ability of producers to stockpile and hedge gold as a commodity. In response to this development, Atlas announced indefinite postponement of the Masbate gold project.

Foreign enthusiasm for joint ventures in developing new mines was dampened by a Government ruling that total returns to a foreign investor from both service fees and return on equity shall not exceed 40% of the net proceeds of the operations. Fourteen international mining corporations attempting to negotiate service contracts for risk investments under Presidential Decree 463 had pulled out of the Philippines by late 1977. Of the five remaining companies, three were disapproved subsequently for exceeding the 40% guideline. Some industry sources felt that if these guidelines were strictly imposed, foreign risk capital in joint ventures for exploration and development of new deposits would in most cases not be forthcoming. The 5% customs duty and the 5% internal revenue aspect of Presidential Decree 1352 would greatly affect the Philippine Sinter Corp. plant (100% owned by Kawasaki Steel Corp. of Japan), which was to process Brazilian and Australian iron ores on Mindanao Island for shipment to Kawasaki's steelworks in Japan.

The Philippine energy supply is based mainly on foreign resources at present, primarily imported crude oil costing nearly $1 billion in 1977. Newly found offshore oil was expected to reduce foreign dependency somewhat. Little coal has been domestically produced or consumed. The Goverment expected to initially develop the capacity to produce 1 million tons per year and perhaps expand capacity to 4 million tons per year in the next decade. The Philippines possesses less than 3,500 megawatts of developed generating capacity, two-thirds thermal (mainly diesel) and one-third hydroelectric. Three hydroelectric projects were being developed. Surveys on uranium resources

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began very recently, and one nuclear plant of 620-megawatt capacity was being built, although its future disposition was unclear. The Philippine Department of Energy, through the National Power Corp., made plans to develop about 1 million kilowatts of geothermal energy within a decade. Unconventional sources of energy, including that generated by solar and wind forces, were being investigated, but so far this research has involved only $1 million annually.

PRODUCTION

The overall mineral production value increased from about $595 million in 1976 to $720 million in 1977.[e] Base metals accounted for 62% of the total value of minerals produced, nonmetals including coal 26%, and precious metals 12%. The Philippines is known more for base metal and precious metal production than for nonmetal production. The Philippines is the largest copper producer in Asia, and copper was the country's single most important mineral, contributing 39% to the total mineral production value, followed by cement at 17%. The country has become a medium-size cement producer. Nickel, accounting for just under 17% of total mineral output value, was the country's second most important metal, ahead of gold at 11%. The Philippines is only a medium-size producer of gold by world standards. It is well known for chromite, particularly refractory chromite, which alone contributed 3% of the total mineral output value. Lead, zinc, and silver together provided just over 2%.

Despite depressed conditions, copper output established a record high, with Atlas and Lepanto providing the margin over the 1976 output. Nickel came into its own, although the smelter still had problems. Good prices and demand revived the chromite industry, although production still was considerably lower than the peak level of 1973. Beach sands operations stopped because export demand dwindled. Manganese output and exports rose sharply despite the downturn in world steel demand. The sluggish performance of the construction industry adversely affected the cement, limestone, sand and gravel, and miscellaneous construction materials industries.

Table 1.—Philippines: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Cadmium, mine output, metal content	15	--	--
Chromium, chromite, gross weight:			
Metallurgical grade	98,986	120,761	134,996
Refractory grade	421,052	310,302	402,126
Total	520,038	431,063	537,122
Cobalt, mine output, metal content	106	492	1,084
Copper, mine output, metal content	225,775	237,588	268,509
Gold troy ounces	[r]502,577	501,210	558,235
Iron and steel:			
Iron ore and concentrate thousand tons	1,351	571	--
Ferroalloys[e]	2,200	2,200	2,200
Lead, mine output, metal content	3,388	4,530	3,753
Manganese ore and concentrate, gross weight	--	10,576	20,599
Mercury, mine output, metal content 76-pound flasks	244	--	--
Nickel, mine output, metal content	[r]9,364	15,239	36,666
Platinum-group metals:			
Palladium troy ounces	836	--	--
Platinum do.	579	--	--
Silver, mine output, metal content thousand troy ounces	1,620	1,481	1,621
Zinc, mine output, metal content	10,453	11,643	12,716
NONMETALS			
Barite	3,803	3,199	5,393
Cement, hydraulic thousand tons	4,264	4,497	4,423
Clays:			
Bentonite	661	2,117	2,279
Red	18,267	8,284	18,737
White	8,102	12,267	11,552
Rock	756	1,498	437
Other	442,658	472,371	370,604
Feldspar	3,907	15,240	14,504

See footnotes at end of table.

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Table 1.—Philippines: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
NONMETALS —Continued			
Fertilizer materials:			
Crude, phosphatic:			
Guano	125,813	1,752	NA
Phosphate rock	5,401	11,703	10,283
Manufactured:			
Nitrogenous[e1]	53,400	[r]62,100	48,400
Mixed and unspecified	[e]80,000	NA	NA
Gypsum and anhydrite[2]	117,983	61,700	[e]60,000
Lime	[r]35,687	27,086	28,184
Perlite	665	1,649	1,492
Pyrite and pyrrhotite (including cupreous), gross weight	161,560	166,331	108,523
Salt, marine	202,060	203,386	213,452
Sand and gravel:			
Alumina sand	28,282	12,601	NA
Glass sand thousand tons	427	391	NA
Other[3] thousand cubic meters	5,265	6,113	NA
Stone:			
Coral, crushed do	157	163	25
Dacite	22,866	12,680	NA
Diorite	86,325	105,835	97,841
Dolomite	5,832	6,432	7,442
Limestone thousand tons	5,806	6,945	6,333
Marble (dimension), unfinished	[r]4,372	4,140	NA
Tuff	49,165	77,123	58,574
Cobbles and boulders, n.e.s thousand cubic meters	47	482	7
Sulfur	75,125	77,344	50,463
Talc	1,342	1,411	1,200
MINERAL FUELS AND RELATED MATERIALS			
Coal, all grades	105,128	120,810	284,013
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	16,294	15,381	15,234
Jet fuel do	2,391	2,353	2,665
Kerosine do	3,259	2,991	3,110
Distillate fuel oil do	13,526	14,148	15,021
Residual fuel oil do	23,815	25,149	27,244
Other do	3,013	3,118	2,959
Refinery fuel and losses do	3,531	3,314	3,639
Total do	65,829	66,454	69,872

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]Data are for years ending June 30 of that stated.

[2]Includes synthetic.

[3]Includes unspecified earths.

TRADE

Total trade in 1977 was about $7.0 billion compared with $6.2 billion in 1976. The trade deficit was cut down from about $1.06 billion in 1976 to $765 million in 1977. Exports rose 21% to $3.1 billion, whereas imports rose less than 8% to $3.9 billion. The foremost import items were mineral fuels and machinery other than electrical, followed by transport equipment, base metals, electrical machinery, cereals, and chemicals. Japan and the United States were the leading trade partners.

Coconut products and sugar were ahead of minerals in importance as exports, with the United States and Japan again the leading trade partners. Philippine mineral exports continued to increase in value, however, rising from approximately $450 million in 1976 to $530 million in 1977. Copper, despite its depressed market, remained the leading mineral export and provided about 45% of mineral export earnings. Nickel and gold followed, furnishing a combined 24% of mineral export earnings.

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Table 2.—Philippines: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal including alloys, all forms	2,081	1,795	Hong Kong 1,028; Japan 346.
Chromium, chromite ore and concentrate	501,350	378,105	Japan 165,839; United States 126,166.
Copper:			
Ore and concentrate	816,333	956,558	Japan 736,177.
Metal including alloys:			
Scrap	100	1,305	Japan 523; Republic of Korea 391; West Germany 222.
Matte	8	8	All to Sweden.
Gold:			
Bullion, thousand troy ounces	155	140	All to United Kingdom.
Metal, rolled, unworked or partly worked, do.	335	395	Japan 299.
Iron and steel:			
Roasted pyrite, thousand tons	17	34	Taiwan 27; Indonesia 4.
Scrap	--	80	All to Taiwan.
Metal, semimanufactures:			
Bars, rods, angles, shapes, sections	10	1	All to United States.
Universals, plates, sheets	7	18,456	Belgium-Luxembourg 16,294.
Tubes, pipes, fittings	1,739	16	United States 13.
Castings and forgings	226	70	Australia 45; Saudi Arabia 15.
Lead:			
Ore and concentrate	3,735	7,395	All to Japan.
Metal including alloys, unwrought and semimanufactures	2	--	
Manganese ore and concentrate	1,518	6,800	Do.
Molybdenum ore and concentrate	32	--	
Nickel:			
Ore and concentrate	225	--	
Metal including alloys, all forms	6,953	12,110	United States 5,550; Netherlands 5,350; Japan 1,210.
Silver metal including alloys, unworked and partly worked:			
Silver, including silver gilt and platinum-plated silver, thousand troy ounces	63	88	All to United Kingdom.
Rolled, do.	242	71	Hong Kong 58; United Kingdom 13.
Zinc:			
Ore and concentrate	14,778	17,490	All to Japan.
Metal including alloys:			
Scrap	354	36	Do.
Unwrought and semimanufactures	(1)	1	All to Indonesia.
Other:			
Ores and concentrates	3,700	--	
Ash and residue containing nonferrous metals	8,120	6,502	United Kingdom 3,598; Taiwan 1,879.
Base metals including alloys, all forms	1	(1)	All to United States.
NONMETALS			
Cement, hydraulic	777,074	662,054	Indonesia 254,197; Iran 144,632; Hong Kong 109,799.
Clays and clay products (including all refractory brick):			
Crude	10	--	
Products, nonrefractory, value, thousands	$2,744	$4,999	United States $2,277; Singapore $1,716.
Fertilizer materials, manufactured, mixed	4	--	
Pyrite	37,076	58,530	All to Japan.
Salt	(1)	(1)	All to Hong Kong.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked, unspecified	14	598	Hong Kong 593.
Worked	1	--	
Gravel and crushed stone	--	1	All to United States.
Quartz and quartzite	7,200	2,875	All to Japan.
Sand, natural (river and sea)	388	13,993	Japan 13,575.
Sulfur, sulfuric acid	82	22	All to United States.
Other:			
Crude	440	566	Indonesia 436; Taiwan 130.
Slag, dross, and similar waste, not metal bearing	4,200	--	
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	231	845	Indonesia 498; Taiwan 182; Malaysia 132.
Hydrogen and other rare gases	3	--	
Petroleum refinery products:			
Gasoline:			
Aviation, thousand 42-gallon barrels	1	--	
Motor, do.	346	693	United States 420; Singapore 98.
Kerosine and jet fuel, do.	372	69	United States 51.
Distillate fuel oil, do.	525	182	United States 153.
Residual fuel oil, do.	r540	--	
Lubricants, do.	189	151	Mainly to Singapore.
Other:			
Mineral jelly and wax, do.	--	(1)	NA.
Asphalt, do.	38	6	Mainly to United States.
Unspecified, do.	3	--	
Total, do.	r2,014	1,101	

rRevised. NA Not available.
[1]Less than 1/2 unit.

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Table 3.—Philippines: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite ore and concentrate	7,589	4,362	All from Malaysia.
Metal including alloys:			
Scrap	49	19	All from United States.
Unwrought	8,458	17,379	United States 6,757; Australia 5,778; Japan 1,132.
Semimanufactures	2,180	2,340	Japan 1,167; United States 469.
Arsenic trioxide, pentoxide, acids	108	106	France 46; United States 45.
Chromium oxide and hydroxide	74	129	West Germany 52; U.S.S.R. 13.
Cobalt oxide and hydroxide	1	4	Belgium-Luxembourg 2; Netherlands 1.
Copper:			
Copper sulfate	61	97	Japan 45; West Germany 20; France 17.
Metals including alloys:			
Unwrought	3,405	4,789	Japan 2,945; Chile 1,149.
Semimanufactures	r2,788	4,233	Japan 2,987; Australia 427.
Gold leaf and gold foil troy ounces	4	--	
Iron and steel metal:			
Scrap	61,363	95,715	Japan 60,128; United States 35,200.
Pig iron, cast iron, powder, shot	28,376	63,203	India 46,612.
Ferroalloys	3,018	2,001	Taiwan 1,097; Japan 367.
Steel, primary forms	286,609	362,384	Australia 165,551; Japan 113,989.
Semimanufactures:			
Bars, rods, angles, shapes, sections	64,282	73,659	Japan 55,744; West Germany 4,656.
Universals, plates, sheets	178,973	344,334	Japan 277,043.
Hoop and strip	15,553	10,940	Japan 5,756; Australia 4,709.
Rails and accessories	11,309	2,283	Japan 1,763.
Wire	11,460	14,439	Japan 12,844.
Tubes, pipes, fittings	28,417	25,000	Japan 1,930; United States 1,027.
Castings and forgings	r94	18	Mainly from Hong Kong.
Lead:			
Oxides	37	27	Australia 21; United States 4.
Metal including alloys, all forms	7,110	5,253	Australia 3,155; United States 406.
Magnesium metal including alloys, all forms	12	41	Mainly from Japan.
Manganese:			
Ore and concentrate	2,571	3,216	United States 2,176; Japan 698.
Oxide and dioxide	1,139	1,056	United States 725; Japan 237.
Mercury 76-pound flasks	159	869	Netherlands 325; France 279.
Molybdenum:			
Ore and concentrate	--	490	All from Japan.
Metal including alloys, all forms	62	3	United States 2.
Nickel metal including alloys, all forms	100	163	West Germany 95; Canada 30; United States 25.
Platinum-group metals, unwrought and semimanufactures troy ounces	(1)	2	All from United Kingdom.
Silver:			
Silver leaf and foil do	1	226	All from United States.
Other, including silver gilt and platinum-plated silver, unwrought and semimanufactures do	526	1,190	Do.
Tin:			
Oxides	2	5	Belgium-Luxembourg 3.
Metal including alloys, all forms	302	294	Malaysia 233.
Titanium:			
Rutile ore and concentrate	573	539	Australia 507.
Oxide and hydroxide	1,363	2,625	United Kingdom 699; Australia 550; West Germany 520.
Tungsten metal including alloys, all forms	3	4	Australia 1; Canada 1.
Zinc:			
Oxide and peroxide	352	494	Japan 253; Taiwan 150; United States 43.
Metal including alloys:			
Scrap	21	--	
Unwrought and semimanufactures	9,512	14,206	Japan 8,255; Australia 4,266.
Other:			
Ores and concentrates of base metals	32	74	Japan 44; Australia 30.
Oxides, hydroxides, peroxides of metals	188	136	Japan 39; West Germany 28; Taiwan 20.
Metalloids	2	7	Japan 4; United States 2.
Nonferrous base metals including alloys, all forms	67	27	Japan 10; People's Republic of China 5; United States 3.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	622	257	Greece 106; United States 78; Netherlands 42.
Dust and powder of precious and semiprecious stones kilograms	r1	4	All from United States.
Grinding and polishing wheels and stones	822	1,063	Japan 246; Taiwan 222; West Germany 135.
Asbestos	1,899	2,471	Canada 1,145; Australia 876; United States 290.
Barite and witherite	2,060	272	Singapore 100; West Germany 44; Australia 36.
Boron materials: Oxide and acid	384	594	Mainly from United States.
Cement	14,580	8,731	Japan 7,933.
Chalk	200	640	All from Japan.

See footnotes at end of table.

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Table 3.—Philippines: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite and fuller's earth	1,045	1,584	United States 963; Japan 280; Belgium-Luxembourg 182.
Fire clay	723	1,397	United States 620; United Kingdom 364; Japan 267.
China clay	4,686	5,226	Japan 1,761; Republic of Korea 1,200; United States 1,112.
Other	7,726	9,946	United States 6,876; Japan 2,144.
Products:			
Refractory (including nonclay brick) value, thousands	$7,765	$6,055	Japan $2,443; United Kingdom $1,150.
Nonrefractory do.	$376	$473	Taiwan $141; Japan $135; Republic of Korea $127.
Diamond, industrial carats	82,020	54,905	All from Congo.
Diatomite and other infusorial earth	1,306	2,485	United States 1,693; Japan 630.
Feldspar and fluorspar	2,649	3,695	India 825; Norway 708; Italy 630.
Fertilizer materials:			
Crude, phosphatic	174,403	60,776	United States 49,667; Australia 9,048.
Manufactured:			
Nitrogenous	87,998	65,764	Japan 40,686; Canada 9,984.
Phosphatic	13,990	25,839	United States 25,802.
Potassic	90,368	73,419	United States 40,128; Canada 30,391.
Other, including mixed	48,746	1,196	West Germany 866; United States 263.
Ammonia	r116,652	271,160	Japan 270,749.
Graphite, natural	168	112	Japan 59; Norway 27; West Germany 18.
Gypsum and plasters:			
Gypsum	24,149	64,328	Japan 63,957.
Plasters	4,093	5,449	West Germany 4,816.
Lime	691	415	Japan 203; United States 166; United Kingdom 46.
Magnesite	879	1,378	Austria 549; People's Republic of China 450; Japan 360.
Mica:			
Crude, including splittings and waste	81	38	India 15; United States 13; West Germany 6.
Worked, including agglomerated splittings	11	14	India 5; Hong Kong 3; United States 3.
Pigments, mineral:			
Natural, crude	2,433	2,392	United Kingdom 1,360; India 1,002.
Iron oxides, processed	1,191	1,596	India 706; West Germany 545.
Salt	46,263	55,151	Australia 53,438.
Sodium compounds:			
Sodium carbonate, natural and manufactured	46,217	67,616	United States 29,687; Romania 15,399.
Caustic soda	12,705	28,751	United States 9,892; Taiwan 5,238; Italy 4,089.
Stone, sand and gravel:			
Dimension stone, crude and worked	104	1,064	Taiwan 627; People's Republic of China 272.
Dolomite	8,812	8,885	Japan 6,938.
Gravel and crushed stone	80	88	United States 70.
Limestone (except dimension)	675	485	All from Japan.
Quartz and quartzite	151	175	Sweden 81; France 50; Netherlands 42.
Sand:			
Silica	7,300	6,277	Australia 6,000.
Other	42	180	United States 104; Australia 30.
Stone for industrial uses (including soapstone), n.e.s	189	37	France 20; Japan 13.
Sulfur:			
Elemental, all forms	25,925	18,944	Canada 18,159.
Sulfur dioxide	13	2	Mainly from United States.
Sulfuric acid	30,002	46,237	Japan 42,217.
Talc	3,546	5,306	Republic of Korea 4,310.
Other:			
Crude	172	1,252	Japan 616; Australia 311; People's Republic of China 300.
Oxides and hydroxides of magnesium, strontium, barium	536	789	Japan 349; Australia 254.
Bromine, iodine, fluorine	5	4	Japan 2; United States 2.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	788	1,598	Republic of Korea 1,370.
Carbon black	268	947	Japan 374; United States 373; Australia 169.
Coal and coke and briquets thereof	15,656	21,320	Japan 14,464; Vietnam 3,755.
Hydrogen and other rare gases	102	133	Japan 85.
Petroleum:			
Crude and partly refined thousand 42gallon barrels	67,176	70,256	Saudi Arabia 25,000; Kuwait 19,545; Indonesia 9,057.
Refinery products:			
Gasoline:			
Aviation do.	358	125	Iran 123.
Motor do.	(2)	--	
Kerosine and jet fuel do.	(2)	--	

See footnotes at end of table.

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Table 3.—Philippines: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS —Continued				
Petroleum: —Continued				
Refinery products: —Continued				
Distillate fuel oil	do	1,994	5,979	Bahrain 2,184; Malaysia 1,816; Saudi Arabia 612.
Lubricants	do	475	295	Canada 189.
Other:				
Liquefied petroleum gas	do	155	286	Singapore 210.
Naphtha	do	1,560	1,229	Malaysia 459; Bahrain 351; Saudi Arabia 159.
Mineral jelly and wax	do	61	90	Indonesia 37; People's Republic of China 20; United States 9.
Unspecified	do	19	17	United Kingdom 7; United States 4.
Total	do	4,622	8,021	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		1,441	1,649	Japan 916; Australia 389.

[r]Revised.
[1]Revised to none.
[2]Less than 1/2 unit.

COMMODITY REVIEW

METALS

Chromite.—As of October 1977, the number of chromite producers had increased to 16—10 producing metallurgical chrome (2 more getting ready) and 5 producing refractory chrome (1 more getting ready)—compared with 11 in 1976 and only 5 in 1975. Prices were good in 1977, and entrepreneurs in the Philippines felt that resumption of the U.S. embargo on Southern Rhodesian chrome would help the sale of Philippine chrome. Consolidated Mines, with 5 million to 6 million tons of refractory chrome reserves at its Cotó property in Zambales Province, recovered from the typhoon damage in 1976 and produced 395,400 tons of product, nearly 100,000 tons more than last year. The other four producers together produced less than 2% of Consolidated Mines' tonnage.

Acoje Mining Co., Inc., dominated the metallurgical chrome scene, although its contribution was only about two-thirds of the total. Acoje's output in 1977 at about 85,200 tons, a fraction more than in 1976, was roughly 12,000 tons less than in 1975. Acoje, with about 1.6 million tons of 22% grade reserves at its Zambales property, was in the process of expanding mill capacity from 800 tons to 1,200 tons of ore per day; despite high prices, its operating income declined from that of last year because of the lower grade of ore mined and milled. Golden Arrow Mining Co. replaced G. Lluch & Sons, Inc. (no longer listed as a producer in 1977) as the second-ranking metallurgical chrome producer in the Philippines, with an output of 11,440 tons in 1977 from its Silanguin plant in San Antonio, Zambales Province, from proven ore reserves on the order of 200,000 tons. Golden Arrow was expanding production slightly. Four less prominent metallurgical chrome producers were Velore Mining Corp., Misamis Exploration Corp., New Frontier Mines, and Inter-Continental, which each produced at one-third to one-half the rate of Golden Arrow.

Cobalt.—Late in 1977, Marinduque announced its intention to construct a $16 million cobalt refinery at its Surigao nickel facility near Nonoc Island, with financing from the Asia Development Bank.[7] In processing the mixed sulfide concentrates hitherto exported to Japan for extracting cobalt, the proposed 3,175-ton-per-year refinery would establish the Philippines as one of the world's foremost cobalt producers. Since the nickel facility has not yet attained design capacity, the cobalt contained in the mixed sulfide concentrates produced was only 1,084 tons in 1977.

Copper.—The Philippines ranked ninth in the world and first in Asia as a producer of mine copper. Its output, while far less than that of the top three (the United States, Chile, and the U.S.S.R.) and considerably smaller even than that of the next three (Canada, Zambia, and Zaire) was of the same magnitude as such producers as Peru, Poland, Australia, and the Republic of South Africa. Copper dominated the Philippine mineral economy, accounting for about 39% of the total mineral output value and 45% of the mineral export value. Copper retained its third-ranking position in

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overall Philippine exports, after coconut products and sugar, and provided more than 10% of the country's foreign exchange in 1977. Production rose 13% over that of 1976, mainly as a result of the gains made by Atlas, through the development of the Carmen pit, and by Lepanto, which resumed operations at its Mankayan mine.

The copper industry was generally depressed, however, owing to poor demand and continued low world prices. This situation caused the temporary closure of some of the smaller producers such as Western Minolco's operation (shut down in November 1977), Acoje's Barlo project, Marinduque's Bagacay mine, Benguet's Wild Cat project, and a copper project owned by Benguet Exploration. Philippine copper production during the second half of 1977, by major producer, was as follows, in tons:

Producer	Concentrate	Copper content
Atlas Consolidated Mining & Development Corp	239,896	72,665
Baguio Gold Mining Co	11,883	2,548
Black Mountain Inc	6,012	1,553
Lepanto Consolidated Mining Co	25,584	9,076
Marcopper Mining Corp	82,460	23,309
Marinduque Mining & Industrial Corp.[1]	50,990	14,690
Philex Mining Corp	64,263	16,855
Western Minolco Corp	15,185	3,509

[1]The bulk is from Sipalay, which produced 45,924 tons of concentrate containing 13,849 tons of mine copper; the rest is from Bagacay.

Source: Philippine Bureau of Mines. Mineral News Service (Manila). September 1978, p. 16.

The Philippine copper smelter project will be built at Palompon and Isabel near Ormoc City in Leyte Province, where there is geothermal potential. The planned annual refined metal capacity was raised from 84,000 tons to 138,000 tons; the smelter is scheduled for operation by 1981-82. The Philippine Government was to own about 40% of the smelting corporation, which will be called Philippine Associated Smelting and Refining Corp. (PASAR). Private mining companies will hold the rest of the shares roughly in proportion to their production levels. There were 14 copper producers in 1976 and 12 by yearend 1977, with the 5 leading producers owning the bulk of the corporate shares. Arther G. McKee & Co. stayed on as project design engineer, and bids were being offered for the roughly 10 major components. In the past, most concentrates have gone to Japan for smelting. The depressed economy there forced the Japanese to raise toll charges. This, in turn, caused great financial hardship on Philippine copper firms which successfully renegotiated for reduced refining charges.

Atlas was again the largest Philippine copper producer, producing from three open pits (Frank, Biga, and Carmen) and one underground mine (Lutopan) on Cebu Island. Yearend 1977 milling capacity was rated at 100,000 tons of ore per day. The tonnage milled in 1977 was 29.75 million tons of 0.49% copper ore, from which 128,989 tons of mine copper, 80,144 troy ounces of gold, 408,000 troy ounces of silver, and 74,630 tons of pyrite were derived. Atlas' ore reserves at yearend stood at 971 million tons of 0.46% copper ore. The 32,000-ton-per-day Carmen pit came onstream 4 months ahead of schedule.

Marcopper, the country's second largest copper producer, produced at about the 1976 level from its Marinduque operations. Reserves were reduced to 68 million tons of porphyry ore after 9 million tons was milled. Marcopper's mine copper output was 47,236 tons in 1977. Construction work for the development of the San Antonio ore body, with 200 million tons of 0.40% to 0.57% copper ore, was started; 27 million tons of tailings and 16 million tons of overburden must first be removed, with production to commence by the early 1980's.

Philex, the third largest copper producer, was also the country's foremost gold producer for the second consecutive year. About 10 million tons of porphyry ore was extracted and milled at its block-caving operations at Baguio, yielding 33,567 tons of mine copper, 185,000 troy ounces of gold, and 312,000 troy ounces of silver in 1977. Philex's output rose over 9% during the year.

Marinduque had to temporarily shut down the Bagacay mine because of depressed copper prices and great difficulties in its nickel business. Marinduque's Sipalay mine carried on as usual, producing 27,130 tons of mine copper from 5.9 million tons of porphyry ore; reserves were about 650 million tons of relatively low-grade ore.

Lepanto, at one time the leader in gold production, staged a strong comeback in 1977 by resuming operations. Its enargite ore has long been a pollution hazard for the old Tacoma smelter which smelted the ore. About 58,000 tons of concentrates containing 18,000 tons of mine copper was extracted from 830,000 tons of 2.4% copper ore, together with 75,000 troy ounces of gold and 263,000 troy ounces of silver during 1977. Roughly 6.4 million tons still remained; relining the Tuba shaft will help to get at Lepanto's ores at lower levels.

Benguet, the well-known gold producer,

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obtained finances for its $85 million, 17,000-ton-per-day Dizon copper-gold project, which should start operations by 1980.

Philippine copper concentrates are all exported, mostly to Japan. Of the 216,250 tons of mine copper exported by the Philippines in 1977, 77% went to Japan; an additional 6% went to the United States. Atlas' output went mainly to Mitsubishi Metal Corp. in Japan, Marcopper and Lepanto continued to ship to North America, Marinduque shipped to Mitsui Mining & Smelting Co., Ltd., and Philex regularly sends concentrates to smelters of Nippon Mining Co., Ltd. About 70,000 tons of Philippine copper concentrates was purchased by the Chinese for future delivery.

Gold.—Philippine gold production reversed its downward trend of the past few years and registered an increase of more than 10% over that of 1976. The gold price moved sharply upward, from $132 per troy ounce in the beginning of 1977 to about $165 at yearend. This prompted roughly a dozen firms to think about developing new gold mines in the next few years; however, the gold price subsequently declined somewhat, causing some prospective producers to reconsider. The Philippine Bureau of Mines was preparing to initiate a new gold mine development program at yearend, with a view toward evaluating potential gold deposits around the country and rendering technical assistance to claim holders on the condition of reimbursement if and when new properties are transformed into commercial operations. The Philippine Board of Investments started to grant incentives to serious investors capable of realizing an equity return of 15% based upon a gold price of $150 per troy ounce.

Atlas raised its monthly byproduct gold output from about 6,200 troy ounces in January 1977 to 10,300 troy ounces in January 1978. Its new Carmen open pit in Cebu Province began commercial operations in October 1977, adding considerable gold values to the gross. However, Atlas was not able to get cheap electricity from the National Power Corp. initially, and this was costly. Marcopper raised its monthly byproduct gold output at its Marinduque copper property from 3,300 troy ounces in January to 6,100 troy ounces in December; facilities had previously been expanded about 50%. The Philippines' leading gold producer, Philex, with its block-caving porphyry copper mine in Baguio, increased byproduct gold production slightly during 1977 under the stimulus of high prices. Benguet, by far the largest primary gold producer in the country, maintained steady output at its Baguio properties while working on deepening the mine and building a new long drainage tunnel; Benguet was also developing a new copper project in Zambales Province called Dizon. Lepanto had an erratic year after resuming production at its mine, also located at Baguio. Philippine gold output in 1977, totaling just under 560,000 troy ounces, included the following shares by leading producers: Philex 33%, Benguet 20%, Atlas 14%, Lepanto 13%, and Marcopper 8%.

The new gold refinery and mint of the Philippine Central Bank in Quezon City successfully completed its first test run in October 1977 and expected full-scale operations shortly. This refinery is rated at 600,000 troy ounces of gold and 450,000 troy ounces of silver per year. Provisions have been made to work on the byproduct gold expected to be recovered from the country's first copper smelter yet to be built. A Government monopoly on purchases of newly mined gold (including byproduct gold) was initiated with the proclamation by the Monetary Board of the Central Bank in early 1978 that local mining firms must deliver all their gold to the Bank's new gold refinery.[8] This monopoly also had the effect of discouraging some would-be miners from opening new gold mines. The Philippine Bureau of Mines would like to promote the establishment of a gold custom mill at Larap, Camarines Norte Province.

Iron Ore.—Iron ore production in the Philippines, which has consisted almost entirely of beach sands in recent years, was negligible in 1977. Filmag (Philippines) Inc., with operations in Ilocos Sur Province, was shut down for nearly a year because of alleged damage to beaches; by the time it was cleared for resumption of production in mid-1977, the Japanese became hesitant about buying the sand, thus leaving about 1 million tons of iron sand reserves still intact. Apex Mining Exploration Co.'s Gonzaga mine on Luzon Island was being readied to supply Japan with about 250,000 tons of iron sand annually for about 8 years. Inco Mining Corp.'s magnetite deposit in the Cagayan area of northern Luzon Island reportedly was also being developed for the Japanese market. About 100,000 tons of pyrite cinders has been produced annually, mainly by the copper companies.

A $250 million, 5-million-ton-per-year iron ore sintering plant was completed in spring of 1977 at the Phividec industrial estate in Villanueva, Misamis Oriental

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Province, in the southern Philippines.[9] The plant belongs to Kawasaki of Japan, which designed it to supply sintered ore to its steelworks in Chiba, Japan. Kawasaki's wholly owned subsidiary Philippine Sinter Corp. runs the facility, which is located on the deepwater Macajalar Bay on the northern coast of Mindanao Island and uses high-grade iron ore from Brazil, Australia, and Canada, and limestone from a quarry in Bohol, central Philippines. Normally, sintered ore crumbles during long-haul shipment, but Kawasaki's new materials-handling technology has overcome this obstacle. Thus, for the first time in steelmaking history, a major producer is sintering 1 million tons of ore per year at an overseas location where power and labor costs are lower.

In late December 1977, Brazil reached an agreement with Kawasaki to use its port facilities at Villanueva on Mindanao Island to distribute Brazilian iron ore to steel mills in the Republic of Korea, the People's Republic of China, and Indonesia. This port can accommodate 250,000-deadweight-ton ore carriers and store 2 million tons of iron ore. Brazilian iron ore brought there by large carriers will then be transshipped by smaller vessels to various Far Eastern markets.

Iron and Steel.—As of fall of 1977, a final decision on the size of the proposed integrated steelworks had not been made. The Philippine Government was considering 2 million to 2.5 million tons per year of steel, and a Japanese mission suggested 1.5 million tons per year with facilities up to the billet and blooming mill stages. Costs no doubt would exceed $1 billion. The location would be Misamis Oriental Province on northern Mindanao Island near Kawasaki's iron ore sintering plant. It may be that the rolling facilities of National Steel Corp. (at Iligan) and of Elizalde Steel Consolidated Inc. (at Rizal) would be expanded to process semimanufactures from the proposed new works. Most of the iron and coal raw materials will have to be imported, and sintered ore probably can be obtained from Kawasaki's nearby plant in the future.

Marcelo Steel Corp. continued to do some pilot plant testing work on its direct-reduction project, even though it apparently had been shelved indefinitely.

Elizalde and National Steel are the main producers of steel products in the Philippines, and they process mostly imported semimanufactures and scrap. National Development Co. plans to build a 200,000-ton-per-year plate mill at Limay in Bataan Province for completion by 1980. Eventually, this project might be supplied by slabs from the proposed new integrated steelworks on Mindanao Island. The Philippines is consuming more than 1.5 million tons of steel products annually, and demand is rising.

Lead-Zinc.—The Philippine lead-zinc mining industry consisted of two primary producers, two unimportant secondary producers, and various prospects. Benguet, with its mine in the Baguio area, is better known for gold than zinc, but its 1977 zinc output of 5,150 tons of concentrates, valued at about $1.7 million, was worth nearly as much as the gold. The other important primary producer, Zambales Base Metals, Inc., produced about 15,000 tons of zinc concentrates during the year, along with nearly 6,300 tons of lead concentrates. Zambales produced all of the country's mine lead. Zambales sells to Japan exclusively, whereas Benguet sells exclusively to the United States. Zambales plans to raise mill capacity from 1,000 tons to 1,300 tons of ore per day, whereas Benguet planned to maintain its capacity. Zambales' reserves of 4% to 5% combined lead-zinc ores can support the proposed output for more than a decade, but Benguet's proven reserves found in small, high-grade veins or pockets are good for only 2 years, although new ore is generally uncovered as extraction progresses. A zinc prospect reported at Toledo, Cebu Province, may have 200,000 tons of 7% zinc ore.

Nickel.—The Surigao nickel refinery of Marinduque increased its production from 45% of design capacity in 1976 to 64% in 1977, which is just over 21,000 tons of contained nickel. The target for 1978 will be only about 22,680 tons of nickel, or 69% of capacity, because of the low price and sluggish world demand. This plant, using Sherritt Gordon's process, has been working the 1.2% nickel, 0.12% cobalt ore from nearby Nonoc Island, which is lower in grade and wetter than originally called for. In 1977, Marinduque obtained 87% of its $138 million revenue from nickel, the rest coming from copper and cement.[10] The company's loss was cut only slightly from that of 1976 because interest costs had risen from $14 million to $22 million in 1977, mainly for financing the $300 million nickel refinery investment. Atlas' proposed Freeport ammonia leach process project on Palawan Island was shelved indefinitely. However, a third project under Rio Tuba

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Nickel Mining Corp. with a mine on Palawan Island started production in early 1977 and shipped its first ore to Japan in mid-1977. The Rio Tuba deposit has 13 million dry tons of reserves to support an annual design capacity of 700,000 tons of wet ore or 11,000 tons of contained nickel.[11] During 1977, Rio Tuba and another new mining operation owned by Infanta Minerals Corp. may have together produced about 15,000 tons of mine nickel.

NONMETALS

Cement.—The sluggish performance of the construction industry in 1977 affected the cement industry, causing a reduction in cement output of 1.6% in tonnage and 5.8% in value. The country's nearly-5-million-ton annual cement capacity was nearly 90% utilized in 1977, and output value was just under $120 million. About 15 cement producers were in the business, with Island Cement Co., Northern Cement Corp., Republic Cement Co., and Midland Cement Corp. among the largest. The Philippines has had large cement markets in roadbuilding and metropolitan construction programs. The export demand was down in 1977. Most limestone for cement manufacture was indigenous, as was the gypsum, which was derived mainly as a byproduct of the phosphate fertilizer industry.

Perlite.—The country's production of perlite has increased considerably in recent years, although output in 1977 was only 1,492 tons. Most of the crude perlite produced has gone to foreign markets, principally Taiwan, Thailand, Singapore, and Australia. However, production is expected to rise sharply in the near future because of sizable reserves and completion of the first "popping" plant in the Philippines. Located in Legaspi City, Albay Province, northwestern Philippines, this plant was being tested at yearend in anticipation of full-scale operations. Most perlite plants require at least a few thousand tons of crude perlite per year for expansion purposes. The Legaspi plant is managed by the U.S. firm Grefco International, although it is 60% Philippine-owned. The most important market for expanded perlite within the Philippines is in filtering; other potential uses include food processing, nickel extraction, beer brewing, lightweight aggregates, oil processing, horticulture, and cryogenic insulation.

MINERAL FUELS

Coal.—Coal exploration and development expenditures totaled over $70 million during 1976-77. Prospecting activities in the Philippines were stimulated by Presidential Decrees 972 and 1174 issued in conjunction with the Coal Development Act of 1976. Coal companies were urged to pool resources to enhance their technical capabilities prior to continuation of mining operations. The cost-recovery allowance was raised to 90% of the gross proceeds, thereby making it attractive for more intensive exploration and improving techniques. As a result, Philippine coal production more than doubled in 1 year, although still a mere 284,000 tons in 1977. Little coal is consumed in the Philippines, and any large demand in the future will probably have to be met by imports, particularly with regard to the high-quality coal needed in steelmaking.

The Department of Energy had contracted the consultant firm Robertson Research International Ltd. of the United Kingdom to evaluate Philippine coal resources, which are said to be 1 billion tons.[12] Particular attention has been focused upon recoverable tonnages. A report by Robertson Research mentions 14 known deposits, with the most promising areas located on Cebu and Semirara Islands and at Malangas (or Lalat and Lumbog). The Department of Energy took over the Uling project in central Cebu Province from the Philippine Bureau of Mines. By drilling 23 holes by yearend, commercially recoverable reserves here were already estimated at 2.5 million tons of Tertiary coal with structurally complex seams as thick as 4 meters. Philippine coal varies greatly in rank and is often low grade and limited in reserves. However, Department of Energy officials mentioned seams up to 30 feet thick and "more coal than we thought we had."

Petroleum.—Two modest discovery oil wells, South Nido and West Nido, were brought in offshore Palawan Island, with flow rates of 7,300 and 9,500 barrels of oil per day, respectively.[13] About half of the money spent for this project was Philippine money. The production-sharing ratio after costs in the Nido area is 60:40 in favor of the Government through the Philippine National Oil Co. (PNOC). The 40% will be shared by members of the consortium as follows: Cities Service Co. (as operator) 52.5%, Oriental Petroleum and Minerals Corp. 33.1%, Basic/Landoil 10.1%, and Philidrill 4.3%. The overall oil exploration expenditure in the Philippines during 1977 was about $92 million, at least 90% by foreign firms. The hope is to produce about 20,000 barrels per day initially. A rush job has been programmed for completion by spring

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of 1979 for the Nido complex.[14] Total cost would be about $40 million, including five development wells for $14 million, a mooring system for $5 million, and production platforms for $4.2 million.

All Philippine oil requirements are presently met by imports, consisting predominantly of crude oil. The cost of oil imports climbed 5% to $952 million in 1977, and the quantity of oil imports rose 7%, reaching nearly 75 million barrels (just over 10 million tons).[15] Saudi Arabia provided the largest share of the crude oil (more than 26 million barrels), followed by Kuwait (13.3 million barrels), Indonesia (nearly 10 million barrels), Iraq (8.7 million barrels), the People's Republic of China (6.1 million barrels), and Iran (4.5 million barrels). The country now has four refineries with a total capacity of 277,000 barrels per day, and PNOC plans to build a new 110,000-barrel-per-day refinery in the next 2 years.

Uranium.—Philippine interest in uranium and nuclear energy started only recently. Plans were made to build two 620-megawatt nuclear plants at Morong, Bataan Province, west of Manila.[16] Westinghouse Electric Corp., the contractor, had already started construction of the first unit, but the second unit may be indefinitely delayed. Even the first unit was encountering serious problems related to spiraling costs and contract awards. Nevertheless, the effort to find uranium for this project got underway. In fact, the Philippine Bureau of Mines had embarked on a 3-year exploration program on behalf of the Philippine Atomic Energy Commission (PAEC). The Bureau was investigating Larap Peninsula, Camarines Norte and Camarines Sur Provinces on Luzon Island, and Zamboanga del Norte and Zamboanga del Sur Provinces on southern Mindanao Island. Subsequently, Philippine National Oil Exploration Co. and PAEC joined to start drilling at the Larap Peninsula mines, the Bagacay mines, and Magna Rosa.

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[1]Supervisory physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Philippine pesos (P) to U.S. dollars at the rate of P7.40 = US$1.00 for 1977 and P7.44 = US$1.00 for 1976.

[3]U.S. Embassy, Manila, Philippines. Industrial Outlook Report—Minerals. State Department Airgram A-102, June 6, 1978, 8 pp.

[4]Mining Journal (London). Mining Annual Review 1978. The Philippines. July 1978, pp. 464-465.

[5]Chamber of Mines of the Philippines Newsletter (Manila). April 1978, p. 1.

[6]Philippine Bureau of Mines. Mines Yearend Review (Manila). December 1977, 6 pp.

[7]Asia Mining (Manila). December 1977, p. 17.

[8]Asia Wall Street Journal (Hong Kong). Apr. 17, 1978, p. 3.

[9]Asia Mining (Manila). May 1977, pp. 30-31.

[10]Asia Wall Street Journal (Hong Kong). Mar. 31, 1978, p. 3.

[11]World Mining (San Francisco). August 1977, p. 99.

[12]Asia Mining (Manila). December 1977, p. 20.

[13]Asia Mining (Manila). March 1978, pp. 18-19.

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The Mineral Industry of Poland

By Tatiana Karpinsky[1]

Poland is a country rich in raw materials. The most important raw materials mined in Poland are hard coal, brown coal, copper ore, lead-zinc ores, iron ore, sulfur, salt, stone, crude oil, and natural gas. Other mineral raw materials of lesser importance to Poland's economy are oil shale, precious and rare metals, and radioactive elements. Some of these metals are obtained as a byproduct of processing complex ores. The country also has reserves of gypsum, barite, kaolin, and other clays.

In 1977, the Polish mining industry produced over 500 million tons of raw materials (including major construction raw materials). Poland is self-sufficient in coal, copper, and sulfur, but the country continues to lack sufficient crude oil, natural gas, iron ore, phosphate, nickel, manganese, tungsten, and chrome resources.

The total value of Poland's gross industrial production in 1977 amounted to 2,702.4 billion zlotys (zl),[2 3] reflecting an increase of 8.6% over 1976 production. Among the country's branches of industry, the electrical and manufacturing industries are the most important. In 1977, they contributed 27.6% of Poland's total industrial output. The metallurgical industry contributed 8.8% of the total output, with ferrous metals contributing 5.7% and nonferrous metals contributing 3.1%. The fuel and power industry contributed 9.8% of the total output; the nonmetals industry contributed 3.5%, and the chemical industry contributed 9.1%.

Poland's economic policies changed in 1977. The emphasis was shifted from industrial expansion programs to programs aimed at improving the satisfaction of the people. More attention was given to production growth for the domestic and export markets. Although in 1975, more than 32% of the national income was allocated to investment projects, this figure dropped in 1977 to 27%. Work was focused on completion of projects already started. Approximately Zl588 billion was invested in Poland's socialized economy in 1977; this was 1.9% more than was invested in 1976. About Zl270.5 billion of this amount was invested in industry. Many new projects were completed, including the Zawiercies, Nowatko, and other steel plants, and extension of the Katowice steel plant. Development of the Rudna copper mine and beneficiation plant and construction of the Glogow 2 copper refinery continued in 1977. In the coal industry, new mines were under development (the Swierclany, Kaszyce, Ornontowice, and Suszec) and the first shaft in the new Lublin coal basin reached the first coal seam. At the Belchatow lignite strip mines, the first large rotary excavator was put into operation. Another excavator was put into operation in the Konin Basin.

Poland ranked 10th in total world industrial output and accounted for about 2.3% of the total world industrial production in 1977. According to Polish sources, the national income of Poland in 1977 increased

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by 5.6%, slightly less than the target increase of 5.8%. Compared with production for 1976, the following production increases, in percent, were reported in 1977: Bituminous coal, 3.8; crude steel, 14.1; rolled steel products, 3.9; electrolytic copper, 13.5; and cement, 7.6. Electric energy production increased 4.8%.[4]

Goals of the Government's annual economic plan for 1977 were not met by the cement, electrical power, and fertilizer industries.

Exports in 1977 increased 11.2% over 1976 exports, falling short of the planned 13% increase. Imports increased 5.4%, but the trade deficit with countries that were not members of the Council for Mutual Economic Assistance (CMEA)[5] decreased. In 1977, there was a substantial increase in trade with the CMEA countries, compared with the previous year's trade.

In 1977, Poland continued to participate in bilateral and multilateral CMEA investment projects. Among the more important bilateral investment projects Poland was participating in were—

1) the sulfur mine at Tarnobrzeg, the copper mine at Lubin, and the Staszic coal mine in Upper Silesia, for which development credit was given by Czechoslovakia;

2) expansion of the Turnow I brown coal mine and development of the new Turnow II mine, for which credit came from the German Democratic Republic; and

3) the potassium mine in the U.S.S.R., for which credit came from Poland.

Participation in multilateral CMEA investment projects included production of asbestos and iron ore in the U.S.S.R. and construction of a 750-kilovolt high-voltage line from Vinnitsa, U.S.S.R. to the Hungarian border, the Orenburg gas pipeline (Soyuz), and the Polotsk oil pipeline. In exchange, it was agreed that Poland would receive additional supplies of asbestos, iron ore, ferrous alloys, crude oil, and natural gas over a period of 12 years, starting in 1979.[6]

Government Policies and Programs.—Poland's economy is centrally planned and controlled by the Government. The Ninth Plenary Session of the Polish United Workers' Party Central Committee accepted all the goals of the 5-Year Plan (1976-80), but decided to take more decisive actions toward improving economic efficiency and easing tensions that arose in certain areas of the economy. Changes were planned for the structure of investments, with emphasis on improving domestic market supplies and exports. No attempt was made to achieve the maximum pace of economic growth or to expand the national income, industrial production, construction, and other areas of the economy to the highest possible degree. For 1978, the annual plan foresees an increase in national income of 5.4% and an industrial output increase of 6.8%. Production of consumer goods, however, is forecast at a level 9.9% higher than production for 1977. In foreign trade, the plan envisages an increase in both exports (10.3%) and imports (3.9%). One of the prime conditions, however, for implementation of the 1978 plan is improved efficiency of the overall economic performance.

PRODUCTION

Coal is the most important fuel in Poland and accounted for 79% of the total primary energy needs in 1977. Extraction of hard coal exceeded 186 million tons, reflecting an increase of 6.9 million tons, compared with 1976 output. Coal output for 1977 placed Poland fourth among the world's coal producers, after the United States, the U.S.S.R., and Mainland China. The biggest contribution to coal production came from the Zabrze and Dobrowo mines. In 1977, there were 65 coal mines in Poland and 344,000 employees in the entire coal industry. The total number of mine workers was 305,000, of which 244,000 worked in underground mines. The share of coal output that was mechanically extracted reached 95% in 1977. The average daily output for a single mine was approximately 8,800 tons. In 1977, Zl25.6 billion was spent for the expansion of coal mines and 20% of that sum paid for the development of new mines.[7]

In 1977, development continued on the new Lublin coal basin, which is expected to supply mostly steam coal, with the first output planned in 1978. Lignite and brown coal production in 1977 increased by 1.5 million tons, compared with 1976, reaching 40.8 million tons. Output from the Turoszow Basin accounted for approximately 60% of the overall production of lignite in Poland. The lignite mines employed about 13,000 people. In 1977, development also continued on the 38-million-ton-per-year-capacity surface mining operation in the Belchatow region.

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In 1977, the extraction of iron ore in Poland decreased by 2.2%, compared with the previous year, and totaled 659,000 tons. Iron content in the ore was approximately 30%. In addition, 16.9 million tons of iron ore and concentrates were imported. Crude steel production increased from 15.6 million tons in 1976 to 17.8 million tons in 1977. Output of rolled products increased 449,000 tons and steel pipes output increased 48,000 tons. The new Katowice metallurgical plant produced more than 1.6 million tons of pig iron, 1.8 million tons of crude steel, and 1.6 million tons of rolled, semifinished products.[8]

The most important achievement of the Katowice steel complex during the year was to put into operation a rolling mill, a middle-size rolling plant, and a second blast furnace.

Copper ore output increased by 1.3 million tons over 1976 output and reached 21.0 million tons. Development of the new copper mine Sieroszewice, with a projected capacity of 15 million tons of ore per year, was underway in 1977.

Production of electrolytic copper increased from 270,000 tons in 1976 to 306,600 tons in 1977. The planned target for installations—to reach an annual capacity of 320,000 tons of electrolytic copper—was not achieved because of delays in building the Glogow 2 plant. It is expected that production of electrolytic copper will reach 365,000 tons in 1978.

Poland is an important producer of zinc because the country has large deposits of zinc and lead ores. In 1977, Poland extracted 5.25 million tons of lead-zinc ore, reflecting an increase of 6.3% over 1976 output. A new mine, Pomorzany, produced about 750,000 tons of ore in 1977. Production of refined lead increased from 80,600 tons in 1976 to 85,400 in 1977 and refined zinc production decreased from 237,000 tons to 228,000 tons. Aluminum production increased slightly in 1977.

The production of 4.8 million tons of elemental sulfur in 1977 placed Poland second among the world's sulfur producers and made the country the biggest producer of sulfur in Europe. Poland's production of sulfuric acid has increased from 3.2 million tons in 1976 to 3.3 million tons in 1977. The largest plants producing sulfuric acid in Poland are situated in Tarnobrzeg at the fertilizer plants in Police and in Gdansk. Poland has reached a high standard in the design and construction of sulfuric acid plants.

Poland possesses rich deposits of rock salt. The most important salt mines and salines are at Inowroclaw, Klodowa, and Wapno. In 1977, production totaled about 4.4 million tons of salt, reflecting an increase of 0.5 million tons over 1976 production. In 1977, Poland processed about 16.5 million tons of crude oil, mainly at the refinery at Plock. Petroleum products were also produced by a considerably modernized plant at Blachovnia, and at the Gdansk refinery. The first stage of the Gdansk refinery was commissioned in 1976.

Natural gas production in Poland increased from 6.7 billion cubic meters in 1976 to 7.2 billion cubic meters in 1977. The use of natural gas in the chemical industry was increasing rapidly.

Table 1.—Poland: Production of mineral commodities[1]

(Thousand metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
METALS				
Aluminum metal, primary	tons	103,000	103,000	104,000
Cadmium metal, primary	do.	370	400	380
Copper:				
Mine output, metal content	do.	230,000	267,000	289,300
Metal:				
Smelter	do.	230,000	240,000	260,000
Refined, including secondary	do.	248,600	270,100	306,600
Iron and steel:				
Iron ore and concentrate, gross weight		1,192	674	659
Metal:				
Pig iron		7,604	7,912	9,516
Ferroalloys:				
Blast furnace		148	124	134
Electric furnace		166	164	174
Steel:				
Crude		15,004	15,639	17,841
Semimanufactures:				
Rolled, excluding pipe		11,085	11,501	11,950
Pipe		1,146	1,135	1,183

See footnotes at end of table.

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Table 1.—Poland: Production of mineral commodities[1] —Continued

(Thousand metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS —Continued			
Lead:			
Mine output, metal content —tons	e r65,000	e r60,000	54,900
Metal, refined, including secondary—do	76,200	80,600	85,400
Nickel, mine output, metal content[e]—do	r2,500	2,800	2,800
Silver, mine output, metal content[e]—thousand troy ounces	r13,200	r16,100	17,700
Zinc:			
Mine output, metal content —tons	e r190,000	e180,000	216,500
Metal, refined, including secondary—do	243,000	237,000	228,000
NONMETALS			
Barite —do	53,500	80,342	88,700
Cement, hydraulic	18,500	19,800	21,300
Clays and clay products:			
Crude:			
Bentonite	50	50	50
Fire clay	1,380	1,261	1,352
Kaolin	84	95	91
Products	827	794	NA
Feldspar[e]	30	30	40
Fertilizer materials, manufactured:			
Nitrogenous:			
Gross weight	4,244	4,225	e4,160
Nitrogen content[2]	1,533	1,548	1,520
Phosphatic:			
Gross weight	2,883	2,842	e2,970
P_2O_5 content[2]	929	928	966
Gypsum and anhydrite, crude[e 3]	1,200	1,250	1,250
Lime (quicklime and hydrated lime)	8,247	8,117	8,047
Magnesite, crude —tons	26,800	25,600	24,900
Salt:			
Rock	1,582	1,652	1,562
Other	1,942	2,166	2,795
Sodium and potassium compounds, n.e.s.:			
Soda ash	715	726	e730
Caustic soda	392	388	458
Stone and sand and gravel:			
Stone:			
Dolomite	2,341	2,393	2,685
Limestone	7,600	7,300	NA
Marlstone	85	--	--
Quartzite	252	265	261
Other	15,937	16,319	17,254
Sand (for molding)	603	NA	NA
Sulfur:			
Native:			
Frasch[e]	4,321	4,341	4,321
Other than Frasch[e]	450	550	450
Total	4,771	4,891	4,771
Bypoduct:			
From metallurgy[e]	r233	r239	314
From petroleum[e]	25	25	35
Total[e]	r2,258	r264	349
From gypsum[e]	55	55	30
Total sulfur	5,084	5,210	5,150
MINERAL FUELS AND RELATED MATERIALS			
Coal:			
Bituminous	171,626	179,302	186,200
Lignite and brown	39,865	39,309	40,800
Total	211,491	218,611	227,000
Coke:			
Coke oven	17,294	17,868	e18,900
Gashouse	1,006	932	e1,000
Total	18,300	18,800	19,900
Fuel briquets, all grades	1,860	1,673	NA
Gas:			
Manufactured:			
Town gas —million cubic feet	20,977	18,964	NA
Coke-oven gas —do	238,126	247,590	NA
Natural, marketed —do	210,580	236,572	253,205
Natural gas liquids:			
Natural gasoline —thousand 42-gallon barrels	285	200	e250
Propane and butane —do	58	58	NA

See footnotes at end of table.

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Table 1.—Poland: Production of mineral commodities[1] —Continued

(Thousand metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS —Continued				
Peat:				
Fuel	tons	3,300	2,000	[e]2,000
Agricultural[e]	do.	35,000	35,000	35,000
Petroleum:				
Crude:				
As reported	thousand tons	553	455	364
Converted	thousand 42-gallon barrels	4,103	3,376	2,701
Refinery products:				
Gasoline	do.	20,290	19,958	
Kerosine (presumably including jet fuel)	do.	1,108	1,132	
Distillate fuel oil	do.	31,772	36,368	
Residual fuel oil	do.	26,547	33,287	
Lubricating oil	do.	2,940	3,052	NA
Grease[e]	do.	100	100	
Paraffin	do.	323	338	
Liquefied petroleum gas	do.	1,659	1,995	
Bitumen	do.	6,727	6,933	
Total[4]	do.	91,466	103,163	[e]110,000

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, antimony, cobalt, germanium, gold, a variety of crude nonmetallic construction materials, and carbon black are also produced; but available information is inadequate to make reliable estimates of output levels. Poland may also produce alumina in small quantities, but details of such an operation, if it exists, are not available.

[2]Includes content of multigradient fertilizers.

[3]Includes building gypsum, as well as an estimate for gypsum used in production of cement.

[4]Total of listed commodities only; excludes products not reported individually, as well as refinery fuel and losses.

TRADE

In 1977, Polish trade turnover (exports plus imports) amounted to Zl89.4 billion,[9] reflecting an 8.0% increase over that of 1976. The value of exports amounted to Zl40.8 billion and the value of imports was Zl48.6 billion. Total exports increased 11.2% (target increase was 13%) and imports increased 5.4% (2.7% target). The annual trade deficit decreased from Zl9.5 billion in 1976 to Zl7.8 billion in 1977. Trade for four main industrial groups in 1977 (in billion exchange zlotys) was as follows:

	1976	1977	Change, percent
Exports:			
Fuel and energy	6.61	6.67	+0.9
Metallurgy	2.30	2.45	+6.5
Electro-machinery	16.07	18.81	+17.1
Chemicals	3.15	3.51	+11.4
Imports:			
Fuel and energy	4.65	5.64	+21.3
Metallurgy	6.90	6.42	-7.0
Electro-machinery	19.46	20.04	+3.0
Chemicals	4.94	5.53	+11.9

Compared with 1976, the most significant mineral export increases (by tonnage) reported for 1977 were as follows (in whole numbers): Sulfur, 25%; copper, 22%; and brown coal, 10%. The following commodity exports decreased: Rolled steel products, 23%; petroleum products, 19%; and coke, 13%.

The most significant increases in 1977 mineral imports, compared with 1976 imports, were as follows: Manganese ore, 30%; crude oil, 9%; natural gas, 8%; iron ore, 7%; and alumina, 2%. Decreases in mineral imports were as follows: Rolled steel products, 27%; steel pipes, 8%, pig iron, 12%; and petroleum products, 22%.[10]

Trade with centrally planned economy countries in recent years has accounted for about 60% of total Polish foreign trade turnover.[11]

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Poland's trade turnover with different country groups for 1977 is shown in the following tabulation:

Country group	Exports		Imports	
	Million zlotys	Percent	Million zlotys	Percent
CMEA and other[1] centrally planned economy countries	24,585	60	25,196	52
European Economic Community (EEC)[2]	7,416	18	11,606	24
European Free Trade Association (EFTA)[3] and other developed market economy countries	5,326	13	9,234	19
Developing countries	3,465	9	2,589	5
Total	40,792	100	48,625	100

[1]China, mainland, Yugoslavia, Vietnam, and North Korea.
[2]Comprises the following countries: Belgium-Luxembourg, Denmark, France, Federal Republic of Germany, Ireland, Italy, the Netherlands, and the United Kingdom.
[3]Comprises the following countries: Austria, Finland, Iceland, Norway, Portugal, Sweden, and Switzerland.

There was a substantial increase in Poland's trade with centrally planned economy countries in 1977. Exports increased 12.5% and imports 16.7% over those of 1976. The largest trade turnover was with the U.S.S.R. and was valued at 6.07 billion rubles (R), reflecting a 15.8% increase over the 1976 turnover. The value of Polish exports to the U.S.S.R. was estimated at R3.2 billion in 1977, including raw materials estimated at R0.6 billion. Total Polish imports from the U.S.S.R. amounted to R2.87 billion, including raw materials estimated at R0.2 billion.[12] Poland plans to reach R6.7 billion in trade with the U.S.S.R. in 1978.[13]

In 1977, the share of Polish imports provided by the Soviet Union was as follows: Crude oil, 77%; iron ore, 73%; pig iron, 80%; nickel, 100%; and aluminum, 62%. The U.S.S.R. has contracted to deliver to Poland in 1978 about 13 million tons of crude oil and 2 million tons of oil products, 6.5 million tons of iron ore in terms of iron content, and 2.8 billion cubic meters of gas; quantities of nonferrous metals, asbestos, and apatite are also contracted for delivery.[14] Polish deliveries to the U.S.S.R. are scheduled to include 100% of the Soviet Union's imports of coal, 99% of its sulfur imports, and 94% of its zinc imports. Polish exports to the U.S.S.R. also include tankers, container ships, hydraulic excavators, heavy bulldozers, mobile cranes, and complete plants, including sulfuric-acid plants. In addition, a number of new areas for joint Polish-Soviet cooperation and specialization were elected. They include production of equipment for nuclear powerplants, offshore drilling equipment, equipment for the iron and steel industry, mining machinery, and equipment for oil processing.

Polish officials expect that the deficit in trade with the U.S.S.R. in 1978 will not exceed R180 million.

Poland's other CMEA trading partners were (in descending order according to the amount of trade): The German Democratic Republic, Czechoslovakia, Hungary, Bulgaria, and Romania.

Poland's Government plans to establish a more active trade turnover with different countries in 1978. Government plans are for Poland to import from Yugoslavia machines, nonferrous metals, minerals, and chemicals, and for Poland to export to Yugoslavia complete plants, machines, manufactured products, coal, and chemicals. The Government expects a 30% greater turnover in 1978 than in 1977.

According to an agreement between Poland and Czechoslovakia, trade is to reach a value of about R1.4 billion in 1978. This is 13% more than was planned for 1977. Machinery and equipment are planned to account for about two-thirds of total trade between the two countries.

Under an agreement with Hungary, trade is to reach a value of R650 million in 1978, or about 11% more than was planned for 1977. Machinery and equipment are scheduled to be the principal trade items. Exports from Poland to Hungary are planned to include coal, coke, and semi-finished products. Poland plans to import from Hungary bauxite, alumina, and oil products. Other plans are for Poland to import from Albania chrome and iron ores and asphalt and for Poland to export to Albania manufactured products and chemicals. Poland's trade agreements are expected to increase exports of Polish coal, electrical energy, sulfur, copper, and industrial products to developed countries.

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Poland's trade with the developing countries in 1977 was valued at about 7% of the country's total foreign trade. The bulk of Polish imports from the developing countries came from Morocco, India, and Brazil. The largest markets for Polish products in the developing countries were Brazil, India, and Libya. Together with Iraq and Iran, these countries receive about half of all the Polish exports that are directed to the developing countries. Since 1974, Poland has become an important supplier of coking coal to the Brazilian steel industry. A Polish-Brazilian agreement signed in 1975 provided for supplies of coking coal to Brazil and iron ore to Poland in the years up to 1985.[15]

Table 2.—Poland: Exports of selected mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal including alloys, all forms	260	11	NA.
Cadmium metal including alloys, all forms	211	--	
Chromium oxide and trioxide	1,351	--	
Copper metal including alloys, unwrought and semimanufactures	108,579	117,953	United Kingdom 34,046; West Germany 26,799; U.S.S.R. 13,591; Czechoslovakia 15,738.
Iron and steel metal:			
Scrap thousand tons	303	111	Yugoslvaia 46; West Germany 26; Switzerland 16; Brazil 11.
Pig iron[1]	3,757	--	
Ferroalloys[2]	1,239	46	All to East Germany.
Steel, primary forms, ingots	3,932	15,406	Czechoslovakia 11,546; Hungary 3,860.
Semimanufactures including iron and steel castings thousand tons	1,318	1,393	Romania 230; West Germany 164; U.S.S.R. 143; East Germany 127.
Lead:			
Ore and concentrate	15,263	17,827	West Germany 8,520; Italy 5,030; France 2,829; U.S.S.R. 1,447.
Metal including alloys, unwrought	40	3,845	United Kingdom 2,997; Austria 600.
Zinc metal including alloys, unwrought and semimanufactures	93,577	63,516	United Kingdom 20,328; U.S.S.R. 16,297; Hungary 6,165.
Other metal, nonferrous semimanufactures including alloys	16,537	17,407	West Germany 7,408; U.S.S.R. 4,229; Japan 1,656.
NONMETALS			
Cement	282,042	584,826	Austria 131,531; Switzerland 123,558; Algeria 89,606; Morocco 79,442.
Clay, refractory and burnt slate	61,771	31,428	Hungary 17,668; East Germany 7,296; Austria 5,505.
Fertilizer materials:			
Manufactured, nitrogenous thousand tons	905	981	India 151; China, mainland, 149; France 116.
Ammonia do	2	--	
Gypsum do	342	262	Denmark 73; Finland 62; Norway 53; Sweden 33; Italy 31.
Lime	34,345	29,557	Czechoslovakia 17,854; Italy 9,099.
Salt:			
Brine	40,765	279,900	Italy 73,990; Czechoslovakia 63,294; Finland 40,528.
Rock	205,176	--	
Sodium and potassium compounds, n.e.s.:			
Caustic soda thousand tons	45	24	West Germany 8; Italy 7; Sri Lanka 3.
Soda ash do	165	178	U.S.S.R. 38; West Germany 31; Czechoslovakia 25; Belgium-Luxembourg 19; Finland 11.
Stone:			
Dolomite	32,062	33,109	West Germany 15,132; Denmark 14,426; Czechoslovakia 3,454.
Crushed stone	812,224	579,324	West Germany 368,140; France 110,912; Sweden 71,904.
Sulfur:			
Elemental thousand tons	3,080	3,530	U.S.S.R. 664; Czechoslovakia 481; United Kingdom 367; France 303.
Sulfuric acid do	306	178	Czechoslovakia 49; Switzerland 49; East Germany 21.

See footnotes at end of table.

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Table 2.—Poland: Exports of selected mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
MINERAL FUELS AND RELATED MATERIALS			
Coal and briquet:			
Bituminous ---------- thousand tons	38,479	38,944	U.S.S.R. 9,375; France 5,778; Italy 3,289; Denmark 3,190.
Lignite and lignite briquets ---------do	3,442	3,184	East Germany 3,078.
Coke ---------do	3,137	3,110	U.S.S.R. 888; East Germany 758; Austria 321; Romania 310.
Peat and peat briquets ----------	18,842	--	
Petroleum refinery products ---- thousand tons	1,601	2,676	Sweden 956; West Germany 650; Denmark 296; Austria 262.

NA Not available.
[1]Includes blast furnace ferroalloys.
[2]Includes electric furnace ferroalloys only.

Table 3.—Poland: Imports of selected mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite and concentrate ----------	119,235	127,417	Italy 109,985; Australia 15,342.
Oxide and hydroxide ----------	271,588	281,060	Italy 146,393; United States; 73,355; Switzerland 61,312.
Metal including alloys, all forms ----------	27,243	21,009	U.S.S.R. 2,525; Switzerland 2,245; France 1,903.
Chromium, ore and concentrate ----------	191,884	194,720	U.S.S.R. 116,720; Albania 51,158.
Copper metal including alloys, unwrought and semimanufactures ----------	13,786	14,427	Sweden 4,562; U.S.S.R. 3,068; Czechoslovakia 1,945.
Iron and steel:			
Ore and concentrate ---- thousand tons	15,423	15,829	U.S.S.R. 11,831; Sweden 2,305.
Metal:			
Scrap ----------do	205	118	United States 50; Czechoslovakia 13; East Germany 13; Belgium-Luxembourg 13.
Pig iron[1] ----------do	1,798	1,974	U.S.S.R. 1,508; Switzerland 259.
Ferroalloys[2] ----------do	15	22	U.S.S.R. 8; Norway 6; Yugoslavia 3; Austria 2.
Steel, primary forms, ingots ----do	488	381	West Germany 105; Romania 148; Austria 39.
Semimanufactures including iron and steel castings ----------do	2,132	2,148	U.S.S.R. 512; West Germany 480; Spain 224.
Lead metal including alloys, unwrought ----------	13,170	12,076	Australia 4,109; U.S.S.R. 3,998; United Kingdom 3,046.
Magnesium metal including alloys, all forms ----	2,022	1,603	Norway 897; Switzerland 270; United Kingdom 226; United States 210.
Manganese ore and concentrate ----------	555,900	538,351	U.S.S.R. 473,697; France 63,443.
Mercury ---------- 76-pound flasks	7,571	--	
Tin metal including alloys, all forms ----------	4,510	5,096	United Kingdom 2,774; Malaysia 906; Bolivia 850.
Tungsten ore and concentrate ----------	3,318	3,762	United Kingdom 3,169; Portugal 324.
Zinc:			
Ore and concentrate ----------	137,196	125,431	Canada 29,313; Iran 23,540; United States 16,172.
Metal including alloys, unwrought and semimanufactures ----------	2,908	3,797	Yugoslavia 1,610; U.S.S.R. 852; France 600; Norway 555.
Other, nonferrous semimanufactures, n.e.s ----	11,387	8,552	Netherlands 3,298; Sweden 1,768; Austria 1,687; East Germany 857.
NONMETALS			
Asbestos ----------	94,412	108,261	U.S.S.R. 70,192; United Kingdom 12,169; Austria 11,351; Italy 8,339.
Barite ----------	24,442	35,058	Turkey 13,628; East Germany 10,052; Morocco 4,815; Bulgaria 4,526.
Cement ---------- thousand tons	680	306	U.S.S.R. 246.
Clays, crude:			
Kaolin (china clay) ----------	155,699	163,651	Czechoslovakia 88,298; U.S.S.R. 37,401.
Refractory clays and burnt slate ----------	36,274	42,986	U.S.S.R. 27,561; Bulgaria 12,602.
Diatomite and other infusorial earth ----------	8,891	--	

See footnotes at end of table.

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Table 3.—Poland: Imports of selected mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Fertilizer materials:			
Crude phosphate:			
Apatite concentrate ___ thousand tons__	806	598	All from U.S.S.R.
Phosphate rock _____do____	2,502	2,634	Morocco 1,680; Tunisia 229; United States 225.
Manufactured:			
Potassic_____do____	2,933	2,857	U.S.S.R. 1,911; East Germany 908.
Other including mixed_____do____	63	65	Belgium-Luxembourg 34; France 11; Sweden 8; Netherlands 6.
Ammonia _____do____	76	67	Australia 34; Italy 21; East Germany 6.
Fluorspar _____	45,130	48,548	East Germany 19,808; Thailand 10,525; China, mainland, 5,447.
Graphite, natural _____	11,583	12,207	Austria 7,996; U.S.S.R. 4,211.
Magnesite, calcined _____	196,298	278,367	North Korea 116,877; Czechoslovakia 63,306; Austria 37,775.
Mica _____	1,763	1,152	India 1,108.
Phosphorous, white _____	4,473	--	
Soda, caustic _____	17,651	--	
Stone:			
Dolomite _____	12,662	9,930	Italy 9,270.
Quartz _____	2,175	--	
Other _____	19,010	20,529	Norway 11,654; Finland 4,077.
Talc _____	24,728	19,960	North Korea 8,573; Czechoslovakia 4,192; Finland 3,242; Austria 2,541.
MINERAL FUELS AND RELATED MATERIALS			
Coal, anthracite and bituminous thousand tons__	1,132	1,130	U.S.S.R. 831; East Germany 299.
Gas, natural _____million cubic feet__	88,639	90,017	All from U.S.S.R.
Petroleum:			
Crude _____ thousand 42-gallon barrels__	13,606	15,095	U.S.S.R. 11,645; United Kingdom 1,278.
Refinery products _____do____	3,133	3,216	U.S.S.R. 1,635; United Kingdom 412.

[1]Includes blast furnace ferroalloys.
[2]Includes electric furnace only.

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COMMODITY REVIEW

METALS

Aluminum.—Production of aluminum in Poland totaled 104,000 tons in 1977, reflecting an increase of 1% over 1976 production. Poland imports all the alumina and bauxite required for its production of aluminum. In 1977, imports of alumina amounted to 286,000 tons. Imported alumina came from Hungary, Yugoslavia, France, the United States, and Guinea; and bauxite was imported from Hungary and Australia. Imports of aluminum and aluminum products came mainly from non-CMEA countries.

According to Polish sources, if domestic production continues to develop at the present rate, aluminum imports will soon cost more than Zl750 million. Plans are to reduce the cost of imports from the non-CMEA countries by about Zl250 million.[16]

The Skawina and Konin primary reduction plants are the principal aluminum production centers in Poland. Plans are to expand the Skawina aluminum plant, which presently has an annual capacity of 55,000 tons. The aluminum powder production section of this plant reached its full capacity in 1977; 400 tons of aluminum powder was produced. Plans are to increase aluminum production by approximately 40,000 tons in 1980. Methods for producing alumina from Polish non-bauxite raw materials are planned to be further developed, and the Nowiny aluminum plant is scheduled for expansion in 1978.

Cadmium.—Polish smelter production of cadmium is derived wholly from zinc ores of domestic origin. The average cadmium content of these ores is estimated at about 0.2%. The bulk of Poland's cadmium production is planned to go to export markets, principally the U.S.S.R. and the United Kingdom.

Copper.—Poland's most important natural resource among nonferrous metals is copper. In 1977, Poland produced 306,600 tons of electrolytic copper, 13.5% over that of 1976.[17] It is expected that in 1980 copper plants will deliver 425,000 tons of electrolytic copper and that Poland's share of world copper production will increase to 5%. In 1977, Poland exported 117,500 tons of copper. Copper was exported to the Federal Republic of Germany, the United Kingdom, France, Belgium-Luxembourg, and Czechoslovakia. Production of copper ores totaled 21.0 million tons in 1977, an increase of 1.3 million tons or 6.6% over 1976 production.

Copper ore deposits are located in the Legnica-Glogow region in southwestern Poland. These copper deposits lie 600 to 1,500 meters below the surface and consist of sulfide ores in relatively thin, flat, black bituminous shale. The average copper content is 1.5%, with about 1.0 troy ounce of silver per ton. Gross reserves of ores grading more than 1% copper are 1.5 billion tons. In 1977, copper ore was mined mainly from the three large undergroundmines Lubin, Polkowice, and Rudna in the Legnica-Glogow copper basin and also from the two smaller mines Konrad and Lena. Projected annual mine capacities are as follows: Lubin, 7 million tons of ore; Polkowice, 8 million tons; and Rudna, 15 million tons.

Poland's fourth largest mine, the Sieroszewice, located to the west of the Polkowice mine, with a projected capacity of about 15 million tons of copper ore per year, continued under development in 1977. In its first stage, the Sieroszewice mine is expected to produce 5.5 million tons of copper ore per year. This stage is expected to be developed in four years.

New installations were put into operation at the Lubin, Polkowice, and Rudna copper mines in 1977. The annual processing capacity at the Lubin concentrator has been increased by about 1 million tons of ore and capacity of the Polkowice concentrator has been increased by 2.7 million tons. At the Rudna mine, processing capacity increased by 1.25 million tons of ore per year. Expansion of the Rudna concentration plant was scheduled for completion in 1979, when the plant is expected to reach an estimated

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capacity of 10 million tons of ore per year.

Two main smelters were in operation in 1977, one at Legnica, with a capacity of 90,000 tons of electrolytic copper per year, and one at Glogow, with a capacity of 160,000 tons per year. The new Glogow 2 copper plant was nearly completed with an anticipated capacity of 150,000 tons of electrolytic copper per year. Some 4,000 workers were employed on the project. The smelting plant was being built under Finnish license for smelting of concentrate with a capacity of 650,000 tons of copper concentrate per year. The first electrolytic copper from the Glogow 2 plant is expected to be produced in January 1978, with a total production of 150,000 tons per year in 1980. The Glogow 2 copper plant is planned to be fully automated and is to include a plant for the manufacture of sulfuric acid from the sulfur present in the copper ore. This plant is scheduled to go into operation in January 1978. The oxygen plant at the site of Glogow 2 produced its first oxygen in November 1977.

In 1977, Poland was seeking $350 million further credit to finance expansion of its copper industry. Development of the Sieroszewice mine and construction of smelting facilities are estimated at $1 billion. A western bank consortium was arranging a $250 million medium-term Euro credit for Poland to finance procurement of equipment and services for expansion of its copper industry. The final loan agreement was expected to be signed in January 1978.

Iron and Steel.—Poland's domestic output of iron ore is not large and only partly meets the needs of the Polish industry. In 1977, Poland produced 659,000 tons of iron ore; this production reflected a decrease of 2.2% from the 1976 level and a decrease of 74.2% from the 1970 level. Iron ore was extracted in Poland from seven mines located in the Czestochowa district and the Leczyca district.

The Polish steel industry is dependent upon imported iron ore; the country purchased 16.9 million tons of ore in 1977. Imports of iron ore and concentrates increased by 1.1 million tons in 1977 or 7% over 1976 imports. Iron ore was imported from the U.S.S.R., Sweden, and Brazil. Poland has a great shortage of ore-handling facilities. In 1977, a modern ore-handling base was under construction in North Port. Part of the base is expected to be completed and in use by the end of 1979. The ore base is planned to include a large storehouse that will make it possible to store an adequate amount of ore in the port.[18]

Geological investigations in Poland have proven the existence of new iron ore deposits in the northeastern part of the country, where several hundred million tons of iron ore were identified at a considerable depth. Development of these deposits is planned to start in the near future.

In 1977, Poland produced 17.8 million tons of crude steel, reflecting an increase of 14.1% over production in 1976. In 1978, steel production in Poland is expected to reach 19 million tons and in 1980 about 22 million tons of production is anticipated. The annual percent increase in Polish crude steel production for each of the following years, compared with production for the previous year, was as follows: 1972, 5.8; 1973, 4.3; 1974, 3.6; 1975, 3.0; and 1976, 4.2.

Output of rolled steel products reached 11.95 million tons in 1977; this was 3.9% higher than 1976 output. Output of steel pipes reached 1.18 million tons, which was 4.2% higher than 1976 output.

Imports of pig iron decreased from 1.97 million tons in 1976 to 1.74 million tons in 1977[19] and imports of rolled steel and pipes decreased from 2.34 million tons to 1.78 million tons. These decreases were a result of the start of operations at the new Katowice metallurgical plant. About 1.1 million tons of rolled steel products were exported in 1977; this amount was 300,000 tons less than was exported in 1976.

There were 27 Polish steel plants in operation in 1977, and most of them were located in the Upper Silesian Industrial District. In 1977, Poland ranked ninth in world crude steel production. The growth rate for steel production in Poland is faster than the world average. The two largest metallurgical plants in Poland are the Lenin and the new Katowice complexes. In 1977, the Lenin steel plant produced about 6 million tons of crude steel and the Katowice metallurgical plant produced about 1.8 million tons. Over the period 1971-76, Poland invested approximately Zl121 billion in development of its steel industry. This was about 20% more than was invested for that purpose in the preceding 20 years.

In 1977, the Nowatko and Zawiercie metallurgical plants, and a number of sections in other steel plants, were renovated and enlarged. The plate mill of the Boleslaw Bierut works at Czestochowa was commissioned, and its production of heavy plate for shipbuilding was expected to reach 1.43

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million tons in 1978. At the Lenin steel plant at Krakow, renovation of the No. 3 blast furnace, built 20 years ago, was in progress. In December 1977, operations began at the Katowice metallurgical complex's second blast furnace, semifinishing rolling mill, and medium section rolling mill. Construction of the third oxygen converter and heavy section rolling mill, with projected capacity of 1.2 million tons of rolled steel per year, is planned to be completed in 1978.

In 1980, the total output of the Katowice metallurgical complex is expected to reach a capacity of 4.4 million tons of pig iron, 4.5 million tons of steel ingots, 4.2 million tons of semifinished sections, and 2.9 million tons of finished products. The projected capacity of 9 million tons of crude steel per year at the Katowice complex is expected to be reached after 1982.[20]

Construction of the new wide-gage railway from the Soviet-Polish border to the Katowice steelplant was underway in 1977.[21] It is expected that the line will be completed in 1980. It is anticipated that some 16 million tons of Soviet ore will be transported each year to the Katowice plant and that Poland will transport about 7 million tons of sulfur per year to the Soviet Union.

Lead and Zinc.—In 1977, Poland produced 5.25 million tons of lead-zinc ores; this output was 6.3% higher than the 1976 output. Lead-zinc ore extraction in Poland had previously increased from 2.5 million tons in 1960 to 4.6 million tons in 1975 and to 4.9 million tons in 1976.

Zinc and lead mining is concentrated in the Katowice area, where three major mines (Boleslaw, Olkusz, and Pomorzany) were in operation in 1977. The Pomorzany underground mine, with a capacity of 4 million tons of ore per year, started production of lead-zinc ore in 1974. In 1977, this mine produced some 750,000 tons of ore.

In 1977, Poland produced 228,000 tons of refined zinc and 85,400 tons of refined lead. Poland accounted for about 4% of the world refined zinc output.[22] Production of zinc decreased 3.8% compared with the 1976 level and production of lead increased 6.0%.

Zinc production is expected to increase to 260,000 tons in 1980, and lead production is projected at 120,000 tons. Exports of zinc and rolled-zinc products increased from 61,605 tons in 1976 to 61,964 tons in 1977. Nearly 60% of these zinc exports went to CMEA countries. The U.S.S.R., Czechoslovakia, and Hungary were the largest importers of Polish zinc. The chief importers among market economy countries were the United Kingdom, Austria, and Norway.

Several lead-zinc mines and smelters have been renovated in Poland. A new Imperial Smelting Furnace—Poland's second such furnace—is scheduled to come onstream at Huta Cynku in 1978. This furnace is planned to renovate the Miosteczko Slaskie plant in Upper Silesia. In addition, the new Pomorzany mine is expected to increase production of lead-zinc ores in the future.

Nickel.—Nickel was recovered in the processing of copper ore as well as from domestic low-grade silicate nickel ores. Poland's production of nickel is used by Polish steel plants, but the bulk of the nickel used in Poland comes from the Soviet Union.

Silver.—The largest share of Poland's total mine production of silver was produced as a byproduct of copper from the Legnice-Glogow region, about 65 kilometers northwest of Wroclaw. Ores from these deposits reportedly yield an average of one ounce of silver per ton. Polish sources indicate that in 1977, the sale of copper byproducts, principally silver, produced enough revenue to cover more than 100% of the direct mining costs at Legnice-Glogow. The balance of the Polish mine output of silver is derived as a byproduct of lead-zinc mining.

NONMETALS

Cement.—Cement output increased from 19.8 million tons in 1976 to 21.3 million tons in 1977. Production of cement is planned to increase to 23.8 million tons in 1978 and to reach 28.6 million tons in 1980. The amount of cement manufactured could not fully satisfy Polish demand and consequently had to be supplemented with imports.

There were 26 cement plants with 109 kilns in operation in Poland in 1977. Of these kilns, all except seven were rotary kilns.

In May 1976, a cement plant at Strzelce in the Opole area was commissioned. It produced 2 million tons of cement from that date to December 1977. The plant's planned capacity is 1.6 million tons of cement per year.

In 1977, two cement plants (one at Gorazdze and another one at Ozarow) were commissioned.[23] The Gorazdze cement plant produced 1.3 million tons of cement in 1977, and is expected to produce 2.4 million tons in 1978.

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Fertilizer Materials.—Poland produces nitrogenous and phosphatic fertilizers, but potassic fertilizers are imported, mainly from the German Democratic Republic. Production capacity of Poland's nitrogen and phosphorous fertilizer industries increases far more slowly than the needs of agriculture. To improve this situation, exports of nitrogenous fertilizers are planned to be decreased and increased imports of phosphatic fertilizers are planned.

In 1977, Poland produced 1,520,000 tons of nitrogenous fertilizers and 965,600 tons of phosphatic fertilizers (both amounts are in terms of nutrient content). Production of nitrogen fertilizers decreased by 28,000 tons, and production of phosphatic fertilizer increased by 37,600 tons, compared with the 1976 levels. Imports of phosphorite and apatite concentrates amounted to 3.6 million tons and imports of potash fertilizers amounted to 3 million tons (in terms of nutrient content).

Over one-half of the output of nitrogenous fertilizers was supplied by the nitrogen plant in Pulawy. Large plants are also located in Wloclawek, Tarnow, and Kedzierzyn. By the end of the current 5-year plan (1978-80), the production of carbamide is expected to increase at the Pulawy nitrogen plant by 75,000 tons per year and at the Kedzierzyn nitrogen plant by 92,000 tons per year.

Also by 1980, a new carbamide installation with a capacity of 300,000 tons per year is planned to be constructed at the Wloclawek nitrogen plant. In addition, a new ammonia production unit is planned to be built at Pulawy and production is scheduled to be increased at existing ammonia installations at Kedzierzyn and Tarnow.[24] Plants producing phosphatic fertilizers have been built in Tarnobrzeg, Police, Lubon, and Cracow. By 1980, powdered superphosphate installations are scheduled for expansion, and production of triple superphosphate is expected to begin at the Szezecin, Wroclaw, Ubocz, and Tarnobrzeg plants. The Police II fertilizer plant, which is being built under a Polish-French agreement at a cost of Zl38 billion,[25] is expected to begin producing ammonia in 1980. This complex is expected to produce 500,000 tons of ammonia annually, 400,000 tons of urea, and more than 800,000 tons of nitrogen-phosphorous-potassium (NPK) fertilizer.

Gypsum.—One of the richest European deposits of gypsum is located in Poland's Nida Valley. This deposit is exploited by the Dolina Nidy mining-processing complex near Pinczow. Polish exports of gypsum total as much as several hundred thousand tons per year. Main importers are Sweden, Denmark, Norway, Finland, and Hungary.

Salt.—The total Polish output of salt amounted to 4.4 million tons in 1977, compared with an output of 3.8 million tons in 1976. The output of rock salt decreased from 1.7 million tons in 1976 to 1.6 million tons in 1977. Some 0.25 million tons of salt were exported in 1977, about half to Western Europe. The rock salt deposits occur along the Carpathian Foreland and in the central part of Poland, near Inowroclaw, Klodawa, and Wapno. In 1977, there were 11 salt mines and plants in Poland, with a total of 4,800 employees.

Poland's total salt reserves amounted to 43.5 billion tons; more than 60% of these reserves are in the Klodawa and Inowroclaw salt regions. The Klodawa mines in central Poland are the country's leading producers of rock salt. The salt near Klodawa and Inowroclaw occurs in the form of large salt domes and is extracted by underground mining and by underground leaching.

Poland's largest salt mine, at Szklodowa in the Klodawa region, extracted 1.2 million tons of salt in 1976; some 460,000 tons of salt was extracted at the Wapno mine (Pila Province).

In 1977, the first brine was pumped out of a new shaft at the Gora mine near Inowroclaw from a depth of 1,200 meters.

Development of the third mine in the Kujawy region started in December 1977 near Mogino. Plans are to pump brine from a depth of 1,400 meters for pipeline transport to the Kujawy-Mozovia chemical works.

In the Carpathian Foreland, the rock salt deposits at Bochnia and Wieliczka, near Tarnow and at Zory in the Rybnik coal region are of less commercial value than salt from the Klodawa, Inowroclaw, and Kujawy regions. A part of the Wieliczka deposit is extracted by underground leaching. The salt mine at Wieliczka is better known as a tourist center than as a commercially valuable mine.

Sulfur.—Poland is a large producer of sulfur. Total production of sulfur was 5.2 million tons in 1977, about the same as in 1976. Sulfur deposits in the Tarnobrzeg basin are the principal contributers to current production.

The largest part of 1977 sulfur production

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came from the Jeziorko mine (2.9 million tons) and the Grzybow mine (1.4 million tons), where sulfur was produced by the Frasch process. The Jeziorko mine near Tarnobrzeg is scheduled to produce 3.2 million tons of sulfur in 1978.

Exports of sulfur reached 4.4 million tons in 1977, reflecting an increase of 25% over 1976 exports. Yugoslavia, China, and the CMEA countries imported over half of Poland's sulfur exports. According to Polish sources, the new mine situated at Smolinka in Przemysl Province has produced 6,000 tons of sulfur since it went into operation in September 1977.

Table 4.—Poland: Supply and apparent consumption of fuels and power

(Million tons of standard coal equivalent[1])

	Total primary energy	Coal (lignite, bituminous) and coke	Crude oil and petroleum products	Natural gas	Other
1976:					
Production	203.7	191.1	0.6	8.9	3.1
Imports	31.6	1.1	27.1	3.4	--
Exports	46.8	42.7	4.1	--	--
Apparent consumption	188.5	149.5	23.6	12.3	3.1
1977:					
Production	211.8	198.3	.7	9.6	3.2
Imports	32.5	1.1	28.0	3.4	--
Exports	46.1	42.8	3.3	--	--
Apparent consumption	198.2	156.6	25.4	13.0	3.2

[1]1 ton standard coal equivalent (SCE)=7,000,000 kilocalories. Conversion factors used are from the United Nations as follows: Hard coal, 1.0; brown coal, 0.3; coke, 0.9; crude oil, 1.47; petroleum products, 1.54; and natural gas (per thousand cubic meters), 1.33.

Source: Biuletyn Statystyczny (Statistical Bulletin), Warsaw. No. 1, 1978, pp. 14, 32, and 34.

MINERAL FUELS

In 1977, Poland's total primary energy production was 211.8 million tons standard coal equivalent (SCE), reflecting an increase of 8.1 million tons over that of 1976. Coal (lignite and bituminous) contributed 93.7% of this total, petroleum contributed 0.3%, natural gas contributed 4.5%, and others (peat, wood, and hydropower) accounted for 1.5% of the total. Total consumption of all types of primary energy reached 198.2 million tons SCE. Shares of total consumption were coal, 79%; petroleum, 12.8%; natural gas, 6.6%; and hydropower, peat, and wood, about 1.6%. In 1977, the total consumption of primary energy increased 5.2% over consumption in 1976. The total energy balance for 1976 and 1977 is shown in table 4.

The Lake Zarnowieckie nuclear powerplant, which is under construction with Soviet assistance, is scheduled to start operations after 1984. In 1990, nuclear power is expected to contribute 13% of the total electrical energy generated in Poland.

Coal.—The coal mining industry has been an important basis for Poland's economic development. In 1977, bituminous coal production reached 186.2 million tons, or about 6.9 million tons more than in 1976.[26] Production of bituminous coal is planned to reach 192 million tons in 1978, 210 million tons in 1980, and 240 million tons in 1985.

Poland is the second largest exporter of coal in the world after the United States. In 1977, Poland exported 39.3 million tons of bituminous coal, or 0.4 million tons more than in 1976. Coal exports accounted for 21.1% of Polish bituminous coal output and 15% of the total value of Polish official total exports. In 1977, approximately 63% of the nation's coal exports went to non-CMEA countries. The largest importers in this group were France, Italy, Denmark, the Federal Republic of Germany, and Belgium-Luxembourg. The remaining 37% of Poland's coal exports went to CMEA-countries. The Soviet Union accounted for 65% of the total Polish coal exports to CMEA countries. Smaller amounts of coal were exported to Czechoslovakia, the German Democratic Republic, Romania, Hungary, and Bulgaria. In 1977, coal exports to the non-CMEA countries accounted for the growth of Poland's coal exports. Further growth of coal exports is anticipated. Brown coal production increased from 39.3 million tons in 1976 to 40.8 million tons in 1977, reflecting an increase of 3.8% that made it possible for Poland to export 3.4 million tons of brown coal, mainly to the German Democratic Republic.

Production of coke reached 19.9 million tons in 1977; this was 5.9% higher than production in 1976. Coke exports decreased from 3.11 million tons in 1976 to 2.72

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million tons in 1977.[27] Coke was exported mainly to the Soviet Union and the German Democratic Republic. Among the non-CMEA countries, the largest importers of Polish coke were Austria, Switzerland, and Finland.

Poland's coal deposits are located in three basins: Upper Silesia (about 75% of all deposits), Lower Silesia (0.5%), and Lublin (24.5%). Coal is mined in Upper Silesia, mainly in the Rybnik coalfield around Katowice. Lignite is mined mainly in the Turoszow district in the Wroclow region and in Konin in the Poznan region.

All hard coal in Poland is mined underground at depths to 600 meters. The average depth is 450 meters. Coal seam thickness varies from 0.8 to 20 meters.

The caloric value of the Upper Silesian coals ranges from 4,800 to 7,800 kilocalories per kilogram. Polish coals tend to be highly volatile. The following quality ranges are indicated for Polish coals: Volatile matter, 20% to 32%; moisture content, 1% to 25%; ash content, 22% to 40%; carbon content, 72% to 90%; and sulfur content, 1% to 3%.

In 1977, development of the Swierclany, Suszec, and Kaczyce mines in the Rybnik basin continued. The Swierclany mine, with a designed capacity of 12,000 tons per day, is expected to produce 8,000 tons of coal per day in 1979. Coal production from a new mine at Suszec is scheduled to begin in 1982. Development of the Halemba mine at Rudna Slaska, which is planned to be the deepest mine in the Polish coal industry, was in progress in 1977. In September 1977, the Grunwald-3 shaft at the Halemba mine reached a depth of more than 1,100 meters, and the Grunwald-4 shaft was also under development. Halemba's daily rate of coal extraction is expected to increase from 14,000 tons to 24,000 tons.

Share of total coal consumption by various sectors in 1977 was as follows: Coke-oven plants, 17%; powerplants, 30%; miscellaneous industries, 30%; transport, 4%; and public utilities, 19%.

In 1977, the first coal seam was reached in the Bogdanka mine in the new Lublin coal basin in East Poland. In 1990, the Lublin basin is expected to produce 16 million tons of coal and increase in 1995 to about 24 million. Coal mines in the Lublin basin are being designed for an output of about 24,000 tons per day. The coal from the Lublin basin is of good quality, with an average value of more than 6,000 calories per kilogram. Total reserves of coal in the Lublin region are estimated at 40,000 million tons.

One of the largest lignite coal mining projects is Belchatow in the central part of Poland. In 1977, the first rotary excavator, with a capacity of 100,000 cubic meters per 24 hours, was put into operation at the Belchatow lignite strip mine. The first million tons of lignite is planned to be produced in 1980. The complete project is scheduled to come onstream in 1985. The major lignite mining project development at Belchatow has a target production capacity of 38 million tons per year. Reserves at the Belchatow basin amounted to 2 billion tons.

According to the development plan, about 15% of the country's total power will be produced at the Belchatow lignite mining and power complex in 1985. In 1977, 30% of Poland's total domestic power production was fueled by lignite.

The total handling capacity of the coal base in North Port amounted to 7 million tons per year in 1977. Plans are to expand the coal base in North Port between 1981 and 1990. The old port at Gdansk has a coal handling capacity of 4.2 million tons per year. Total cargo-handling capacity of all Polish ports is expected to rise from 59 million tons per year to 75 million tons in 1980.[28]

A project for coal gasification involving the Krupp-Koppers Co. of Essen is expected to be completed in 1982.

Construction of an 80-kilometer, 22-inch-diameter pilot coal-slurry pipeline is planned to start in 1978. Poland is seeking assistance and agreements for cooperation from U.S. firms for construction of coal-slurry pipelines and expansion of coal exports.

Natural Gas.—Extraction of natural gas in 1977 totaled 7.2 billion cubic meters; this was 7.0% more than was extracted in 1976. Most of the indigenous natural gas was extracted from the Carpathian Foreland.

Poland imported 2,759 million cubic meters of gas from the U.S.S.R. Deliveries of natural gas are planned to increase by 2.8 billion cubic meters after completion of the Soyuz pipeline.[29] The first deliveries of natural gas from the Soviet city of Orenburg are expected in October 1978. Under a 20-year agreement, Poland is to receive 2.8 billion cubic meters of natural gas per year in return for its investment in construction of the Soyuz gas pipeline.

Petroleum.—Crude oil is produced in Poland in small quantities. In 1977, output of crude oil amounted to 364,000 tons. Imports of crude oil reached 16.4 million tons, or 1.3 million tons more than was imported in 1976. 1977 imports of petroleum products amounted to 2.5 million tons.

In 1977, Poland's refineries produced

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approximately 16.5 million tons of petroleum products, reflecting an increase of 6.2% over 1976 production. Under a contract signed between Poland and the Soviet Union, about 12.7 million tons of crude oil and 2.0 million tons of petroleum products are to be imported in 1978.[30]

Imports of crude oil from Arab countries are scheduled to increase considerably in 1978. The CMEA countries—including Poland—are expected to pay 20% more than they paid in 1977 for oil imported from the Soviet Union.

Poland exported 2.2 million tons of petroleum products and synthetic fuels, a total that is 0.5 million tons less than was exported in 1976.

The Plock refinery processed about three-quarters of the oil imported by Poland, or nearly 12.3 million tons. The Gdansk refinery has almost attained its designed capacity of 3 million tons per year. The Gdansk refinery is expected to export 820,000 tons of petroleum products in 1980, mostly to the Scandinavian countries.

Construction of a new refinery at Blachownia, near Kedzierzya-Kozle in Opole Province, with an initial capacity of 3 million tons per year, continued in 1977. This refinery is scheduled to go into operation in 1980.

About 40% of Poland's crude oil reserves occur in Poland's Lowlands, some 40% are in the Carpathian Mountains, and about 20% are in the Carpathian foothills.[31]

In October 1977, Polish workers completed a 440-kilometer Soviet crude oil pipeline. It extends from Polotsk in Byelorussia westward across southern Latvia and into Lithuania through Bizhay to the town of Mazejeikial, about 90 kilometers from the Baltic Coast. For its assistance in construction of the Polotsk line, Poland is promised an extra 1 million tons of Soviet crude oil per year at CMEA prices.

Poland, the Soviet Union, and the German Democratic Republic have signed an agreement to carry out geological prospecting for oil in the Baltic Sea on the Polish Shelf. An extensive geophysical research has convinced the Governments of the three countries that oil exists in the offshore Baltic waters shared by these three countries. The company is named the Petrobaltic and is located at Gdansk, where the first offshore test well is planned to be sunk.

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[1]Foreign mineral specialist, Branch of Foreign Data.
[2]Concise Statistical Yearbook of Poland, Warsaw. 1978, p. 8.
[3]Depending upon the purpose of the exchange, the value of the Polish zloty (Zl) may vary considerably. Where necessary, values have been converted from zlotys (Zl) to U.S. dollars at the official exchange rates of Zl3.32=US$1.00 (basic rate) and Zl19.92=US$1.00 (special commercial rate).
[4]Trybuna Ludu, Warsaw. Feb. 6, 1978, p. 3.
[5]Member countries of CMEA were Bulgaria, Cuba, Czechoslovakia, the German Democratic Republic, Hungary, Mongolia, Poland, Romania, and the U.S.S.R.
[6]Polish Foreign Trade, Warsaw. January 1978, p. 26.
[7]Polska Agencja Interpress, Facts About Poland, Warsaw. 1977, p. 74.
[8]Zycie Gospodarcze (Economic Life), Warsaw. No. 7, Feb. 12, 1978, p. 9.
[9]Biuletyn Statystyczny (Statistical Bulletin), Warsaw. January 1978, pp. 32-33.
[10]Pages 32-34 of work cited in footnote 8.
[11]Trybuna Ludu, Warsaw. Mar. 21, 1978, p. 5.
[12]Perspektywy, Warsaw. No. 3, Jan. 20, 1978, p. 6.
[13]Foreign Trade, Moscow. No. 3, 1978, p. 9.
[14]Trybuna Ludu, Warsaw. Dec. 18, 1977.
[15]Polish Foreign Trade, Warsaw. No. 11, 1977, p. 11.
[16]Gospodarka Planova, Warsaw. July-August 1977, pp. 334-341.
[17]Page 84 of work cited in footnote 2.
[18]Gdansk Technika I Gospodarka Morska. No. 8, August 1977, pp. 490-492.
[19]Work cited in footnote 8.
[20]Gospodarka Planova, Warsaw. No. 7-8, 1977, pp. 334-341.
[21]Trybuna Ludu, Warsaw. Mar. 2, 1978, p. 1.
[22]Rocznik Statystyczny, Warsaw. 1977, p. 475.
[23]Die Wirtschaft. No. 4, 1978, p. 32.
[24]Trybuna Ludu, Warsaw. Mar. 30, 1978, pp. 3-4.
[25]Nowe Drogi, Warsaw. May 1977, pp. 74-81.
[26]Trybuna Ludu, Warsaw. Jan. 3, 1978, p. 1.
[27]Biuletyn Statystyczny (Statistical Bulletin), Warsaw. February 1978.
[28]Gdansk Technika I Gospodarka Morska, No. 9. 1977, pp. 567-568.
[29]Pravda, Bratislava. Feb. 7, 1978, p. 2.
[30]Polityka, Supplement, Warsaw. No. 11, Mar. 19, 1978, p. 18.
[31]Geologiya Nefti i Gasa (Oil and Gas Geology), Moscow. No. 4, 1977, p. 60.

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The Mineral Industry of Portugal

By Roman V. Sondermayer[1]

During 1977, Portugal remained a modest producer of minerals and related products by world standards. However, its tungsten output accounted for about 4% of world production. Production of coal, tin, tungsten, pyrite, gold, copper, iron and steel, beryl, feldspar, uranium, and cement was of only domestic significance.

The gross national product (GNP) was $16.6 billion in 1977. Inflation was at an annual rate of 30%. The mineral industry, including processing, accounted for about 5% of the GNP and employed about 3% of the total labor force.

During 1977, plans were afoot to develop the Moncorvo iron ore deposits in northern Portugal and to increase mine output of pyrite and nonferrous sulfide ores, including construction of new facilities for recovery of sulfur, iron, copper, zinc, lead, and silver. Construction started on an iron cinder pelletizing plant at Sines.

PRODUCTION AND TRADE

Activities of the mining industry were small by European standards, and the mining industry's enterprises were in the hands of both private capital and the Government. Table 1 shows 1975-77 production statistics for Portugal.

Portugal was a net importer of minerals. By value, minerals imports were 9 times as high as exports, chiefly owing to imports of petroleum and high-rank coals. Tables 2 and 3 show details of Portugal's foreign trade in minerals.

The United States had a positive minerals trade balance with Portugal during 1977. U.S. exports were valued at $27.9 million and imports at $11.8 million. As table 4 shows, major U.S. export items were coal and iron and steel products. Ferroalloys were the bulk of imports from Portugal.

Table 1.—Portugal: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Arsenic, white	256	278	[e]240
Beryl concentrate, gross weight	21	--	--
Columbite-tantalite concentrate, gross weight	11	5	2
Copper:			
Mine output, metal content:			
In cupreous pyrite	4,618	4,162	[e]3,600
In other ore and concentrate	[r]477	387	259
In precipitate[e]	10	11	7
Total	[r]5,105	4,560	3,866

See footnotes at end of table.

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Table 1.—Portugal: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS —Continued			
Copper —Continued			
Metal:			
Smelter[e]	3,200	3,200	3,200
Refined primary	2,742	2,754	3,392
Gold, mine output, metal content—troy ounces	11,446	10,031	8,694
Iron and steel:			
Iron ore and concentrate, gross weight:			
Hematite	33,850	2,353	70
Magnetite	1,818	29,081	21,669
Manganiferous	20,410	17,870	30,250
Total	56,078	49,304	51,989
Pig iron—thousand tons	327	344	357
Ferroalloys:			
Ferrotungsten	303	282	r162
Other	8,563	11,669	r16,290
Total	8,866	11,951	16,452
Steel, crude—thousand tons	417	463	537
Steel semimanufactures—do	r360	436	561
Lead metal:			
Primary	486	496	123
Refined (presumably including secondary)	340	116	241
Silver, mine output, metal content—troy ounces	24,885	28,325	24,548
Tin:			
Mine output, metal content	375	332	258
Metal	409	319	r430
Titanium, ilmenite concentrate, gross weight	212	367	188
Tungsten, mine output, metal content	1,424	1,260	1,010
Uranium oxide (U_3O_8)	r95	119	r120
NONMETALS			
Asbestos	(1)	(1)	--
Barite	2,429	90	590
Cement, hydraulic—thousand tons	3,381	3,713	4,296
Clays:			
Kaolin	59,355	50,516	62,619
Other	88,423	85,070	NA
Diatomite	2,090	3,150	3,390
Feldspar	16,374	13,323	10,803
Fertilizer materials, manufactured:			
Nitrogenous, gross weight—thousand tons	505	656	726
Phosphatic, gross weight—do	226	336	270
Mixed and unspecified—do	290	385	415
Gypsum and anhydrite	149,873	101,699	r160,000
Lime (quick and hydrated)—thousand tons	215	222	227
Lithium minerals, lepidolite	1,200	1,200	1,000
Pyrite and pyrrhotite (including cupreous):			
Gross weight—thousand tons	462	416	362
Sulfur content—do	202	181	157
Salt:			
Rock—do	r294	306	350
Marine—do	213	163	r150
Total—do	507	469	500
Sand and gravel:			
Gravel—do	224	325	NA
Sand—do	5,537	5,138	NA
Sodium compounds, n.e.s.:			
Sodium carbonate	115,185	114,137	129,724
Sodium sulfate	51,489	48,894	46,479
Stone:			
Calcareous:			
Dolomite—do	67	75	NA
Limestone, marl, calcite—do	6,596	6,556	NA
Marble—do	279	253	NA
Other:			
Basalt—do	42	78	NA
Diorite—do	6,985	12,651	NA
Gabbro—do	--	8	NA
Granite—do	4,124	3,243	NA
Graywacke—do	32	20	NA
Ophite—do	43	51	NA

See footnotes at end of table.

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Table 1.—Portugal: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
NONMETALS —Continued			
Stone —Continued			
Other —Continued			
Porphyry ---------- do	121	104	NA
Quartz ---------- do	101	80	93
Quartzite ---------- do	179	279	NA
Schist ---------- do	168	134	NA
Serpentine ---------- do	1	1	NA
Slate ---------- do	43	38	NA
Syenite ---------- do	5	6	NA
Talc ----------	1,570	1,146	1,507
MINERAL FUELS AND RELATED MATERIALS			
Coal, anthracite ---------- thousand tons	222	193	195
Coke, metallurgical ---------- do	178	199	206
Fuel briquets, all grades ---------- do	1	1	[e]1
Gas, manufactured ---------- million cubic feet	[e]13,000	NA	NA
Petroleum refinery Products:			
Gasoline ---------- thousand 42-gallon barrels	6,406	6,521	5,983
Jet fuel ---------- do	2,930	2,945	3,076
Kerosine ---------- do	524	565	464
Residual fuel oil ---------- do	14,441	15,416	17,100
Distillate ---------- do	9,164	9,287	9,296
Lubricants ---------- do	473	518	677
Other:			
Liquefied petroleum gas ---------- do	1,478	1,472	1,662
Asphalt ---------- do	224	205	315
Unspecified ---------- do	2,248	2,558	2,559
Refinery fuel and loss ---------- do	3,784	3,434	3,577
Total ---------- do	41,672	42,921	44,709

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.
[1]Revised to zero.

Table 2.—Portugal: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal including alloys, all forms ----------	[r]1,486	2,262	Spain 1,965.
Arsenic trioxide, pentoxide, acids ----------	176	87	Australia 44; Argentina 19; Spain 15.
Chromium oxide and hydroxide ----------	([1])	--	
Columbium and tantalum, tantalum ore and concentrate ----------	11	4	All to Netherlands.
Copper:			
Copper sulfate ----------	129	100	All to São Tomé and Principe.
Metal including alloys, all forms ----------	[r]1,670	1,621	United States 709; Sweden 417; United Kingdom 342.
Gold:			
Waste and sweepings ---------- troy ounces	334	--	
Metal ---------- do	32	--	
Iron and steel:			
Ore and concentrate including roasted pyrite:			
Roasted pyrite ----------	37,681	106,254	Mainly to West Germany.
Other ----------	--	4	All to Cape Verde Islands.
Metal:			
Scrap ----------	1,719	2,805	Belgium-Luxembourg 1,222; Netherlands 946.
Pig iron, ferroalloys, similar materials ----------	47,191	62,259	United States 15,513; Italy 11,787.
Semimanufactures:			
Bars, rods, angles, shapes, sections ----------	1,451	45,179	Egypt 29,748; Syria 4,915.
Universals, plates, sheets ----------	13,044	11,280	Romania 9,362; Hungary 1,449.
Hoop and strip ----------	757	434	Morocco 300.
Rails and accessories ----------	([1])	8	Guinea Bissau 7.
Wire ----------	2,377	4,253	Greece 3,000; Spain 999.
Tubes, pipes, fittings ----------	5,047	6,955	Spain 3,054; Italy 1,042.
Castings and forgings, rough ----------	3,323	3,517	United Kingdom 1,266; United States 765; Sweden 650.
Lead:			
Ore and concentrate ----------	--	([1])	Mainly to Angola.
Oxides ----------	7	2	Mainly to Mozambique.

See footnotes at end of table.

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Table 2.—Portugal: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Manganese: Ore and concentrate	--	14,005	United States 5,525; France 5,000; Spain 1,800.
Mercury 76-pound flasks	--	5,802	All to Angola.
Nickel metal including alloys, all forms	61	39	Mainly to Netherlands.
Platinum group metals and silver:			
Waste and sweepings thousand troy ounces	r585	109	Netherlands 51; United Kingdom 51.
Metals including alloys:			
Platinum group troy ounces	1,412	2,819	Greece 2,121; West Germany 472.
Silver do	4,087	--	
Tin metal including alloys, all forms	73	63	Netherlands 16; United Kingdom 11; West Germany 10; Belgium-Luxembourg 9.
Tungsten: Ore and concentrate	1,940	1,874	United Kingdom 659; United States 360; Poland 324.
Zinc:			
Ore and concentrate	(1)	--	
Oxide	1,366	2,890	West Germany 1,176; Belgium-Luxembourg 702.
Metal including alloys, all forms	94	200	Greece 109; Belgium-Luxembourg 38; Italy 23.
Other:			
Ores and concentrates:			
Of titanium, vanadium and zirconium	540	--	
Of base metals, not elsewhere specified	309	--	
Ash and residue containing nonferrous metals	585	252	West Germany 91; Netherlands 72; United Kingdom 41; Belgium-Luxembourg 28.
Oxides, hydroxides, peroxides of metals, n.e.s.	110	(1)	Mainly to Zaire.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	15	5	Mainly to Mozambique.
Asbestos	(1)	--	
Barite and witherite	234	2,466	Egypt 1,000; Iceland 841; United Kingdom 625.
Cement	96,739	38,281	Brazil 17,104; Cape Verde Islands 13,777; United Kingdom 3,660.
Chalk	50	13	All to Cape Verde Islands.
Clays and clay products (including all refractory brick):			
Crude:			
Kaolin	3	(1)	All to United Kingdom.
Other	651	438	Spain 335; Mozambique 100.
Products:			
Refractory (including nonclay brick)	684	433	Spain 345; Cape Verde Islands 64.
Nonrefractory	10,318	10,826	Spain 2,758; Cape Verde Islands 2,504; United Kingdom 1,031.
Diamond:			
Gem, not set or strung thousand carats	5,180	290	NA.
Industrial do	1,990	361	NA.
Diatomite and other infusorial earths	21	1,018	Mainly to Morocco.
Feldspar, leucite, nepheline, etc	3,000	1,946	France 800; Italy 665; Belgium-Luxembourg 260; Spain 200.
Fertilizer materials, natural and manufactured:			
Nitrogenous	243,020	147,389	Netherlands 50,425; West Germany 34,802; Belgium-Luxembourg 33,320.
Phosphatic	64,630	90,769	Brazil 54,803; West Germany 10,000; Nigeria 10,000.
Potassic	3	693	Brazil 500; United Kingdom 193.
Other, including mixed	4,068	9,664	People's Republic of China 3,984; Belgium-Luxembourg 3,000.
Ammonia	58,128	26,722	Spain 9,348; Greece 7,437; Turkey 4,970; Algeria 3,291.
Graphite, natural	13	44	Mainly to Spain.
Gypsum and plasters	49	79	Mozambique 54; Cape Verde Islands 14.
Lime	439	476	Mozambique 144; São Tomé and Principe 136; Cape Verde Islands 133; Guinea Bissau 63.
Magnesite	2	--	
Mica, all forms	--	498	United Kingdom 388; West Germany 110.
Pigments, mineral:			
Natural, crude	88	33	Guinea Bissau 21; Mozambique 7; Cape Verde Islands 4.

See footnotes at end of table.

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Table 2.—Portugal: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Pigments, mineral —Continued			
Iron oxides, processed	24	18	Cape Verde Islands 9; Mozambique 4; São Tomé and Principe 4; Guinea Bissau 1.
Pyrite, gross weight	61,820	20,218	All to Belgium-Luxembourg.
Salt	568	16,311	Zaire 14,627.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	3,274	620	Angola 256; São Tomé and Principe 136; Mozambique 100; Zaire 100.
Caustic potash and potassic peroxides	5	13	Guinea Bissau 8; Cape Verde Islands 4.
Stone sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Marble and other calcareous	105,966	95,681	Italy 29,375; Spain 25,902; Belgium-Luxembourg 15,076; West Germany 13,439.
Slate	6,240	8,039	Belgium-Luxembourg 3,189; West Germany 1,461; Denmark 1,253; Netherlands 1,043; France 829.
Granite and other	25,426	15,849	Japan 8,234; Italy 4,240; Spain 1,073.
Worked:			
Slate	7,110	6,329	Netherlands 1,598; West Germany 1,423; Sweden 910; Belgium-Luxembourg 808.
Paving and flagstone	96,914	99,089	West Germany 53,756; Denmark 14,678; United Kingdom 13,354.
Marble and other	29,862	22,572	West Germany 9,061; France 3,690; Spain 2,639.
Gravel and crushed rock	43,970	22,156	Gibraltar 21,765.
Limestone (except dimension)	145	50	Cape Verde Islands 36; Angola 9; São Tomé and Principe 5.
Quartz and quartzite	59,847	63,361	Norway 36,136; Italy 18,600.
Sand, exxluding metal bearing	66,140	31,298	Gibraltar 26,260.
Sulfur:			
Sulfuric acid	6,546	140	Cape Verde Islands 92; Zaire 30.
Talc, steatite, soapstone, pyrophyllite	21	18	Mainly to Mozambique.
Other:			
Slag, dross, and similar waste, not metal bearing, from iron and steel manufacture	1,000	5,310	France 5,100.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	2,025	2,611	Cape Verde Islands 2,553.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	24	2	Mozambique 1.
Carbon black	2	1	All to Mozambique.
Coke and semicoke	16	97	All to Belgium-Luxembourg.
Hydrogen and rare gases	(1)	2	Angola 1; Guinea Bissau 1.
Petroleum refinery products:			
Bunker deliveries:			
Gasoline, aviation thousand 42-gallon barrels	5	5	NA.
Kerosine do	(1)	1	
Jet fuel do	r943	1,251	
Distillate fuel oil do	r13	(1)	
Residual fuel oil do	r591	653	
Lubricants do	r15	43	
Total do	r1,567	1,953	
Nonbunker deliveries:			
Gasoline: Motor do	43	21	Guinea Bissau 12; Cape Verde Islands 9.
Kerosine do	r73	25	Cape Verde Islands 20; Guinea Bissau 5.
Jet fuel do	r7	6	Mainly to Guinea Bissau.
Lubricants do	r123	71	United Kingdom 31; Spain 21; Belgium-Luxembourg 8.
Other:			
Liquefied petroleum gas do	r10	6	Cape Verde Islands 4; Gibraltar 1; São Tomé and Principe 1.
Mineral jelly and wax do	r37	1	Mainly to Cape Verde Islands.
Unspecified do	(1)	(1)	NA.
Total do	293	130	
Grand total do	r1,860	2,083	

rRevised. NA Not available.
1Less than 1/2 unit.

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Table 3.—Portugal: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite and concentrate	1,300	1,522	France 1,014; West Germany 498.
Metal including alloys, all forms:			
Scrap	r33	24	Gibraltar 12; United States 5; Netherlands 3.
Unwrought	4,776	9,431	France 2,347; Norway 2,215; Spain 1,856.
Semimanufactures	r9,229	15,585	West Germany 5,203; Austria 2,401; Belgium-Luxembourg 1,971.
Beryllium, beryl ore and concentrate	383	118	Australia 100; United Kingdom 18.
Chromium:			
Chromite	57	713	Netherlands 140; Finland 109; West Germany 103.
Oxide and hydroxide	112	215	West Germany 177.
Cobalt oxide and hydroxide	5	12	Belgium-Luxembourg 8; United Kingdom 3.
Copper:			
Ore	50	15,163	Republic of South Africa 15,103.
Copper sulfate solution	311	(1)	All from west Germany.
Metal including alloys:			
Unwrought:			
Blister	1,345	337	Zambia 287; United Kingdom 50.
Refined unalloyed	8,740	9,804	Canada 4,655; Belgium-Luxembourg 2,700; United Kingdom 1,349.
Other	498	507	Mainly from United Kingdom.
Semimanufactures	r6,958	7,152	France 2,641; United Kingdom 1,214; Italy 850.
Gold metal, unworked or partly worked, troy ounces	r2,942	2,941	United States 1,082; Switzerland 975; Belgium-Luxembourg 872.
Iron and steel:			
Ore and concentrate	386,028	534,395	Brazil 146,683; Republic of South Africa 127,192; Mauritania 111,450; Canada 85,942.
Metal:			
Scrap	5,482	28,588	United States 13,493; West Germany 7,642; Belgium-Luxembourg 3,341.
Pig iron, ferroalloys, similar materials	r36,100	34,308	Spain 24,894; Canada 3,585.
Steel, primary forms	85,955	208,183	Japan 95,951; United States 59,798; Netherlands 21,780.
Semimanufactures:			
Bars, rods, angles, shapes, sections	121,134	94,160	Belgium-Luxembourg 16,302; West Germany 15,592; Sweden 14,257.
Universals, plates, sheets	193,445	171,234	Japan 75,842; West Germany 31,896; Belgium-Luxembourg 19,007.
Hoop and strip	23,108	45,619	West Germany 22,565; Belgium-Luxembourg 14,204.
Rails and accessories	26,882	16,007	France 9,617; Belgium-Luxembourg 4,119 West Germany 1,931.
Wire	15,609	15,777	United Kingdom 4,065; West Germany 3,286; Belgium-Luxembourg 2,703; Japan 1,990.
Tubes, pipes, fittings	29,733	35,660	France 20,939; West Germany 6,476.
Castings and forgings, rough	637	415	Switzerland 106; West Germany 104.
Lead:			
Oxides	54	43	United Kingdom 40.
Metal including alloys:			
Scrap	77	182	Gibraltar 113; Guinea-Bissau 61.
Unwrought	8,362	13,797	United Kingdom 11,149.
Semimanufactures	47	52	Belgium-Luxembourg 25; France 14; United Kingdom 7.
Magnesium metal including alloys, all forms	4	5	Netherlands 2; Japan 1.
Manganese:			
Ore and concentrate	50,617	37,658	Republic of South Africa 17,108; Gabon 15,334; Ghana 5,194.
Metal including alloys, all forms	282	1,414	Netherlands 633; United Kingdom 553.
Mercury, 76-pound flasks	r447	1,271	Spain 917; Italy 200.
Molybdenum metal including alloys, all forms	600	4,000	Netherlands 2,000; Italy 1,000.
Nickel metal including alloys:			
Scrap	142	15	Netherlands 12; Finland 3.
Unwrought	71	69	Netherlands 38; United Kingdom 16; Finland 6.
Semimanufactures	317	467	West Germany 174; United Kingdom 109; Finland 101.
Platinum group metals and silver:			
Waste and sweepings, troy ounces	96	--	
Metals including alloys:			
Platinum gorup, do	r2,411	4,843	France 1,302; Spain 1,182; West Germany 1,102.

See footnotes at end of table.

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Table 3.—Portugal: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Platinum group metals and silver —Continued			
Metals including alloys —Continued			
Silver ____ thousand troy ounces	450	772	United Kingdom 386; West Germany 289; Switzerland 64.
Rare earth metals, oxides	11	20	France 16; United Kingdom 3.
Tin:			
Ore and concentrate	--	100	Indonesia 60; Singapore 40.
Oxides	16	34	West Germany 26; United Kingdom 6.
Metal including alloys:			
Scrap	2	(1)	NA.
Unwrought	307	471	United Kingdom 195; Netherlands 172; Belgium-Luxembourg 100.
Semimanufactures	19	70	France 43; Netherlands 10; United Kingdom 10.
Titanium:			
Ore and concentrate, rutile	180	239	Australia 179; United Kingdom 60.
Oxides	2,832	6,613	United Kingdom 1,736; West Germany 1,360; Finland 1,196; France 1,117.
Tungsten metal including alloys, all forms	--	(1)	Mainly from West Germany and Switzerland.
Zinc:			
Ore and concentrate	--	18	All from United Kingdom.
Oxide	112	227	West Germany 70; United Kingdom 65; Norway 40; Belgium-Luxembourg 25.
Metal including alloys:			
Scrap	36	--	
Blue powder	47	196	United Kingdom 134; Norway 62.
Unwrought	8,131	12,885	Belgium-Luxembourg 4,199; Netherlands 2,982; France 2,452; United Kingdom 1,701.
Semimanufactures	859	1,076	Belgium-Luxembourg 461; Netherlands 242; West Germany 191.
Other:			
Ores and concentrates:			
Of titanium, vanadium, and zirconium	734	879	Australia 809.
Of base metals, not elsewhere specified	169	101	Mainly from Sweden.
Oxides, hydroxides and peroxides of metals, n.e.s	1,939	1,914	United Kingdom 1,516.
Metals including alloys, all forms:			
Metalloids	r676	224	Spain 140; Sweden 69.
Alkali, alkaline earth, rare earth metals ____ kilograms	200	100	All from West Germany.
Pyrophoric alloys	2	3	Austria 1; United Kingdom 1.
Base metals including alloys, all forms, n.e.s	119	180	Belgium-Luxembourg 68; China, Mainland 43; Netherlands 27; Italy 18.
NONMETALS			
Abrasives:			
Natural, n.e.s.:			
Pumice, emery, natural corundum, etc	239	630	Italy 400; Netherlands 152.
Dust and powder of precious and semiprecious stones (including diamond) ____ kilograms	20	48	United Kingdom 33.
Grinding and polishing wheels and stones	308	425	United Kingdom 92; Italy 88; West Germany 65; Japan 54; Spain 48.
Artificial corundum	581	857	West Germany 444; France 272; Austria 63.
Asbestos	5,778	13,028	Republic of South Africa 4,506; Canada 3,622; U.S.S.R. 2,412.
Barite and witherite	2,135	485	West Germany 352; Spain 65; France 42.
Boron materials:			
Crude natural borates	785	3,160	Turkey 3,100.
Oxide and acid	290	134	France 78; Belgium-Luxembourg 30; Turkey 20.
Cement	1,588	45,991	Spain 22,663; United Kingdom 18,028.
Chalk	5,887	7,796	Spain 3,209; France 2,014; United Kingdom 1,294; Belgium-Luxembourg 1,244.
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite	11,121	15,622	Spain 12,087; Netherlands 1,321.
Kaolin	4,760	6,211	United Kingdom 4,546; France 1,296.
Other	64	1,062	West Germany 991.
Products:			
Refractory (including nonclay brick)	8,183	9,061	West Germany 3,890; Austria 1,592; United Kingdom 1,070.
Nonrefractory	1,585	350	NA.
Cryolite and chiolite	30	50	All from Denmark.

See footnotes at end of table.

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Table 3.—Portugal: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Diamond, except powder and dust:			
Gem, not set or strung ____ thousand carats	r17	45	United Kingdom 24; Belgium-Luxembourg 20.
Industrial ____ do ____	r2	3	Netherlands 2; Belgium-Luxembourg 1.
Unclassified ____ do ____	r1,093	354	Angola 338.
Diatomite and other infusorial earth	2,772	3,032	Spain 1,494; United States 738; West Germany 338.
Feldspar, leucite, nepheline, etc	2,301	1,976	Spain 1,150; United Kingdom 595; France 219.
Fertilizer materials:			
Crude, phosphatic	r310,026	338,930	Morocco 329,774.
Manufactured:			
Nitrogenous	1,801	3,484	France 1,659; Spain 1,471.
Phosphatic	2,834	6,468	Morocco 3,000; France 1,368; Tunisia 950.
Potassic	35,109	58,469	Spain 47,685; West Germany 10,783.
Other, including mixed	17,136	20,919	United States 17,368; Tunisia 2,998.
Graphite, natural	217	284	United Kingdom 176; Netherlands 72.
Gypsum and plasters	21,136	25,104	Morocco 23,959.
Iodine	7	2	All from Japan.
Lime, hydraulic	11	--	
Magnesite	1,291	594	Netherlands 336; Spain 171.
Mica:			
Crude, including splittings and waste	314	448	Norway 347; United Kingdom 66; France 24.
Worked, including aggolmerated splittings	15	16	Switzerland 6; Belgium-Luxembourg 4; Spain 3; United Kingdom 1.
Pigments, mineral:			
Natural, crude	22	57	Spain 38; France 10; Austria 5.
Iron oxides, processed	1,577	2,051	West Germany 1,049; Spain 751; Netherland 98.
Salt and brine	33,045	15,011	Italy 14,950.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	44	3,620	Spain 3,586.
Caustic potash, sodic and potassic peroxides	360	368	Italy 320; Belgium-Luxembourg 20.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	1,804	703	All from Angola.
Worked	92	120	Spain 72; Italy 27; Belgium-Luxembourg 12.
Dolomite, chiefly refractory grade	4,140	5,807	Italy 3,451; Norway 1,811; Spain 411.
Gravel and crushed rock	253	58	France 40; Spain 17.
Quartz and quartzite	262	242	Sweden 150; Belgium-Luxembourg 53; Switzerland 27.
Sand, excluding metal bearing	6,307	6,950	Spain 4,641; Belgium-Luxembourg 1,787.
Sulfur:			
Elemental:			
Other than colloidal	27,280	29,870	France 28,784.
Colloidal	45	37	Mainly from West Germany.
Sulfur dioxide	249	255	West Germany 108; Netherlands 72; Spain 60.
Sulfuric acid	25,535	25,780	Poland 11,627; West Germany 7,364; 3,115; Switzerland 3,107.
Talc, steatite, soapstone, pyrophyllite	2,685	3,485	France 1,543; Norway 884; Netherlands 233; Italy 172.
Other nonmetals, n.e.s.:			
Crude:			
Other	900	1,520	Spain 1,494.
Slag, dross and similar waste, not metal bearing:			
From iron and steel manufacture	4,002	--	
Slag and ash, n.e.s	2	--	
Oxides and hydroxides of magnesium, strontium, barium	2,737	4,895	United Kingdom 2,672.
Bromine and other halogens (excluding iodine)	11	12	Japan 10; West Germany 1.
Building materials of asphalt asbestos, and fiber cement and unfired nonmetals, n.e.s	927	424	NA.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	273	1,025	West Germany 460; France 340; Netherlands 154.
Carbon black and gas carbon:			
Carbon black	7,204	9,192	Spain 3,854; France 2,917; United Kingdom 969.
Gas carbon	--	45	Mainly from West Germany.
Coal, all grades including briquets ____ thousand tons	r372	408	United States 239; Poland 159.

See footnotes at end of table.

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Table 3.—Portugal: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS — Continued			
Coke and semicoke ____ thousand tons	37	49	United Kingdom 30; France 10; West Germany 5.
Hydrogen and rare gases	8	5	West Germany 3; Netherlands 2.
Peat including peat briquets and litter	710	203	West Germany 125; Finland 43; Switzerland 35.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	r41,129	43,746	Saudi Arabia 12,680; Iraq 12,349; Iran 9,036; U.S.S.R. 7,713.
Refinery products:			
Gasoline:			
Aviation ____ do	r77	144	Netherlands 86; Israel 31; Italy 10.
Motor ____ do	r142	38	Israel 24; Netherlands 9; Italy 5.
Total ____ do	219	182	
Kerosine and jet fuel ____ do	r359	84	Italy 38; Spain 34; Netherlands 12.
Distillate fuel oil ____ do	r886	1,206	Spain 384; Belgium-Luxembourg 259; Netherlands 250; United Kingdom 124.
Residual fuel oil ____ do	r2,470	1,895	Romania 346; Netherlands 284; Venezuela 263; Curaçao 258.
Lubricants ____ do	r59	101	Netherlands 34; France 28; United Kingdom 24.
Other:			
Liquefied petroleum gas ____ do	r2,743	3,241	France 1,115; Netherlands 708; United Kingdom 641; Italy 376.
Mineral jelly and wax ____ do	r7	14	West Germany 9; Netherlands 2; Japan 1; United Kingdom 1.
White spirit ____ do	r11	8	Netherlands 3; Belgium-Luxembourg 3; France 2.
Unspecified ____ do	r257	459	Spain 163; Netherlands 56.
Grand total ____ do	r7,011	7,190	
Mineral tar and other coal, petroleum, or gas-derived crude chemicals	6,930	10,503	Netherlands 4,968; Spain 1,433.

rRevised. NA Not available.
1Less than 1/2 unit.
2Includes pyrite.

COMMODITY REVIEW

METALS

Iron and Steel.—Planning for development of a domestic supply of iron ore and the startup of a new steel plant, the second in the country, were the major events in the iron and steel industry during 1977.

Iron Ore.—Imported iron ore and imported pyrite cinders remained the principal sources of iron ore. Economic conditions in the country, the balance of payments problem, and high unemployment made development of domestic iron ore deposits located in remote areas more attractive. The Moncorvo iron deposit, situated in northern Portugal, was again the object of exploration activities. The ore body occurs in a range of hills reaching a height of 900 meters and extending over 10 kilometers. The main deposits, with estimated reserves of all categories, follow in million tons:

Deposit	Estimated reserves
Cabeco de Mua	82
Carvalhosa	58
Santa Maria	9
Pedrada	180
Reboredo	186
Couto Minerio	34

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Table 4.—Portugal: Mineral trade with the United States, 1976[1]

Commodity	Exports		Imports	
	Quantity (metric tons)	Value, thousands	Quantity (metric tons)	Value, thousands
METALS				
Aluminum metal including alloys	--	--	123	$242
Copper metal including alloys	671	$882	5	27
Iron and steel metal:				
Scrap	--	--	21,594	1,656
Ferroalloys	20,900	5,843	--	--
Steel, primary forms	--	--	NA	1
Semimanufactures:				
Bars and angles	--	--	24	23
Plates and sheets	--	--	2,399	1,219
Hoop and strip	--	--	41,576	9,536
Wire	--	--	4	9
Tubes and pipes	--	--	24	109
Castings and forgings	373	366	34	83
Nickel metal including alloys	--	--	30	153
Platinum-group metals and silver:				
Platinum-group	NA	1,077	--	--
Silver metal including alloys	--	--	13	355
Radioactive and associated materials	--	--	NA	1
Tin metal including alloys	--	--	2	11
Zinc metal including alloys	15	47	--	--
Other nonferrous metals:				
Ores and concentrates, n.e.s.	327	2,386	--	--
Base metals including alloys, n.e.s.	--	--	(2)	5
NONMETALS				
Abrasives, natural, including diamond	--	--	1,145	122
Fertilizer materials: Crude, phosphatic	--	--	3,842	129
Salt, sodium chloride	2	8	--	--
Stone, sand and gravel:				
Dimension stone	4,514	1,219	--	--
Crushed and broken stone, sand and gravel	--	--	19	5
Sulfuric acid	--	--	4	4
MINERAL FUELS AND RELATED MATERIALS				
Coal, all types	--	--	233,989	13,551
Petroleum refinery products:				
Lubricants	--	--	733	498
Petroleum coke, asphalt, etc	--	--	396	197
Total	XX	11,828	XX	27,936

NA Not available. XX Not applicable.
[1]Data may differ from those reported elsewhere in this chapter owing to a difference in source.
[2]Less than 1/2 unit.

Source: U.S. Department of Commerce, Bureau of the Census.

Three deposits, Cabeco de Mua, Santa Maria, and Pedrada, were selected for the first Moncorvo project by the operator, Ferominas S.A.R.L. Aggregated reserves of these deposits, which were taken into account for economic evaluation, were reported at 271 million tons of ore with an average iron content of 38.9%. Phosphorus content was 0.5%. Hematite is the main iron mineral. Magnetite is also present at the surface but accounted for only 5% of the surface ore. Quartz and sericite are the predominant gangue minerals, averaging 25% and 15%, respectively, of the total.

Plans call for an open pit mine (ore-to-waste ratio 1:0.47), a gravity concentrator, and a pelletizing plant. Capacity was geared toward annual output of 1.5 million tons of pellets by 1980, increasing to 3 million tons after 5 years of operation. In addition to mining facilities, a railroad link between Villa Franca das Naves and Pocinho may be built for transportation of ore to Seixal.

Steel.—A new 200,000-ton-per-year steel plant started production at Maia, north Portugal, in early 1977 but experienced startup difficulties. The largest steel producer remained the plant at Seixal (400,000 tons annual capacity), operated by Siderurgia Nacional S.A.R.L.

Pyrites.—During 1977, pyrites produced in Portugal were used for output of sulfuric acid. However, the Government planned to develop facilities for producing iron pellets from the resultant cinder, and for recovering associated lead, zinc, copper, and gold.

The largest deposits of pyrite and base metal sulfate ores are located in Alentejo Province. Reserves were estimated at 240 million tons, of which about 40 million tons

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were proven at the end of 1977. The average grade of ore was reported as follows: sulfur, 41% to 46%; iron, 39%; lead, 0.9% to 1.2%; and zinc, 2.2% to 3%. Two deposits, Aljustrel (80 kilometers east of Sines) and Lousal Caveira (36 kilometers north of Aljustrel), were in production, but only sulfur was recovered by two fertilizer producers. During 1977, Cia. União Fabril (CUF) started construction of an iron pelletizing plant at Sines. Technology was provided by Kawasaki Steel Corp. of Japan. Principal raw material will be cinder stored at CUF's sulfuric acid plant at Sines.

In addition, after several years of geological and geophysical research, the French Bureau de Recherches Géologiques et Minières (BRGM) announced discovery of a significant deposit of complex sulfide ore near Neves-Corvo, in southern Portugal. The new deposit is located under 300 meters of cover and contains pyrite, lead, zinc, and silver. However, metal content of samples was not made public at yearend.

Tungsten.—Beralt Tin and Wolfram (Portugal) S.A.R.L. decided to spend about $3 million on capital expenditure at the Panasqueria mine in the central Province of Beira Baixa, including a new shaft. Other expenditures were to be for exploration. During 1977, the financial performance of the Beralt operation in Portugal was affected by exchange losses resulting from the 15% devaluation of the Portuguese escudo and its depreciation against the British pound. Preliminary figures indicated losses reaching approximately $3 million.

NONMETALS

Cement.—Cement was among the most important nonmetals produced in Portugal. At the end of 1977, three companies operated 10 cement plants with an estimated capacity of 5.9 million tons. The largest operating company was Cimentos de Portugal E.P. (CIMPOR) which owns 75% of the country's cement production capacity. CIMPOR operated six cement plants; the one at Alhandra (1.9 million tons annual capacity) was the largest in the country.

Fertilizers.—The Portuguese Ministry of Industry decided to restructure ammonia and fertilizer production into two new public entities, Quimigal E.P. and Petroquimica e Gas E.P. In addition, the Government tentatively decided to consolidate or cancel several investment projects for production of ammonia, nitric acid, and manufactured fertilizer. Details were not made public in 1977.

Pumice.—Exploration for pumice continued on the volcanic island of São Miguel in the Azores. Activities have been centered near the village of Sete Cidades, and reserves of about 10 million tons of pumice were confirmed. A processing installation (principally a screening plant) for pumice was completed near the capital of São Miguel, Ponta Delgada, approximately 20 kilometers from the mining site, by the operator, Sociedade Industrial de Pedra-Pones dos Azores Lda., and first shipments were made in February. Planned shipments of 500,000 tons in the first year of full production (1979) should grow to 1.2 million tons after 3 years. Markets in the northern United States were expected to absorb the new output.

Salt.—During 1977, Povoa de Santa Iria, 50 kilometers north of Lisbon, remained the major center for production of salt. Soda Povoa S.A.R.L., a Solvay subsidiary, produced vacuum salt and brine. Most of the salt was used for production of soda ash, chlorine, and caustic soda on the site at Povoa.

Stone.—Stone was an important mineral product of Portugal. The area around Vila Vicosa-Borba-Estremos, east of Lisbon, remained the major stone producer, accounting for about 70% of the total output.

During 1977, about 300 stone-producing facilities were operational in Portugal. Employment averaged about 3,000 persons.

MINERAL FUELS

Portugal remained dependent on imported fuels for almost all of its energy requirements. Imports were mostly liquid hydrocarbons, but some high-rank coals and coke were also imported. Coal, mostly anthracite, continued to be the principal mineral fuel produced, contributing about 1.8% of the apparent energy consumed in Portugal. The following table shows supply and apparent consumption of fuels and power for 1975 and 1976, the latest years for which complete data were available.

Coal.—About 200,000 tons of coal was produced in Portugal during 1977, all from one mine, a Government-owned operation in northern Portugal near Oporto.

Petroleum and Natural Gas.—There was no production of petroleum or natural gas in Portugal during 1977. Petroleum refineries processed imported crude oil, mostly

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Table 5.—Portugal: Supply and apparent consumption of fuels and power for 1975 and 1976[1]

(Million tons of standard coal equivalent[2])

	Total primary energy	Coal and coke	Petroleum and refinery products	Natural gas	Peat, fuelwood, and other fuels	Hydroelectric power	Nuclear power
1975:							
Production	1.2	0.2	--	--	--	1.0	--
Imports	10.5	.6	9.4	(3)	0.3	.2	--
Exports	1.1	(3)	.5	(3)	--	.6	--
Apparent consumption	10.6	.8	8.9	(3)	.3	.6	--
1976:							
Production	1.3	.2	--	--	--	1.1	--
Imports	10.4	.4	9.7	(3)	e.2	e.1	--
Exports	1.0	--	.5	(3)	--	e.5	--
Apparent consumption	10.7	.6	9.2	(3)	e.2	e.7	--

eEstimated.
[1]Includes nonenergy uses.
[2]1 ton standard coal equivalent (SCE) = 7 million kilocalories.
[3]Less than 0.1 million tons of SCE.

from Iraq, Iran, and Saudi Arabia. In addition, Portugal imported petroleum refinery products from Western European countries. During 1977, efforts were made to revive exploration for oil and gas in Portugal, which had been sluggish and without positive results during past years. In 1977, the Government established the Gabinete para e Pesquisa e Exploracão de Petroleo (GPEP) to coordinate exploration efforts. In the fall of 1977, GPEP offered 22 onshore blocks covering most of the western and southern coastal territory. Terms called for a minimum program of geophysical and drilling work over a period of 4 years, and the Government reserved the right to take a minimum of 50% participation in commercial discoveries. Response to this offer by oil operators had not been made public at yearend.

Construction continued on a 6-million-ton-per-year petroleum refinery at Sines, 90 kilometers south of Lisbon. Completion was scheduled for 1978.

During 1977, two refineries, with an aggregate capacity of about 9 million tons, operated in Portugal and processed about 6 million tons of crude oil.

Uranium.—During 1977, limited exploration for uranium was carried out in two regions, Portalegre and Viseu-Guarda. No major events were reported related to production. Urgeirica Mines, with its beneficiation facility, remained the major producer of yellow cake. Measured reserves of uranium (U_3O_8), located near Moncorvo, Viseu, Guarda, and Nisa, were reported to be about 7,000 tons. Some reports showed 30,000 tons of U_3O_8 in all types of reserves in Portugal.

[1]Physical scientist, Branch of Foreign Data.

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The Mineral Industry of Southern Rhodesia

By Janice L. W. Jolly[1]

The Rhodesian economy has traditionally rested on three vital sectors, mining, manufacturing, and farming, all of which showed a decline in 1977. The first sector, including minerals and metals, was well developed before the Unilateral Declaration of Independence (UDI) and was the most healthy sector until 1977, when expansion was discontinued and several projects were set aside. The other two, manufacturing and farming, had been at first strengthened considerably by sanctions. In 1977, however, the volume index of manufacturing production had declined by 6.4%. Mining and quarrying contributed about 7% to the nation's gross domestic product (GDP), estimated at $3,552 million.[2] At market prices, the GDP rose by 2.5% during 1977 but contracted in real terms by 6.9%, making 1977 the third successive year of negative growth. The depressed conditions were attributed to the continuing war and deteriorating security situation, the international and domestic recession, loss of technical and management personnel, and stricter enforcement of sanctions.[3] The Rhodesian dollar was devalued by 6% in October 1977. Inflation, estimated at a rate of 10%, was also a problem.

PRODUCTION AND TRADE

Mineral production was valued at $379.2 million in 1977, compared with $368.8 million in 1976. But while mining production volume had increased 7% in 1976 (compared with that of 1975), it had dropped by 5% in 1977. Industrial production of metals and metal products also showed a 14.8% decline. The decline in real value of mineral production was attributed by the Rhodesian Government to a weakening of international commodity markets as well as a tightening of sanctions, particularly the repeal of the Byrd Amendment by the U.S. Congress.

Because of the secrecy that shrouds imports and exports for security reasons, little detailed information was available. Exports in 1977 decreased in general by 2.5% in value and 6.3% in volume, compared with that of 1976. Imports, in general, increased by 1.1% in value but decreased 8.1% in volume. Stricter measures were taken in the second half of 1977 to reduce foreign exchange allocations granted for imports.

The small increase in mineral production value resulted in great part from higher gold and tin prices. Rhodesian gold output in 1977, although no official figures were available, was estimated to be 600,000 troy ounces. By September 1977, gold was bringing $149 per ounce on the Rhodesian market. Most of Rhodesia's gold was derived from three large mining groups, Coronation Syndicate Ltd. (Corsyn), Falcon Mines Ltd., and Rio Tinto (Rhodesia) Ltd.'s properties. There has also been a renewal in the number of small-scale activities by lesser known operators. More than 500 of the country's 1,000 gold mines were reexamined in recent years, spurred by the improving gold market, and more than 200 of these were back in operation. Thirty were reinstated in 1976, and a further 10 mines were reactivated in 1977.[4]

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Table 1.—Southern Rhodesia: Production of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Antimony, mine output metal content[e]	300	300	300
Beryllium, beryl concentrate, gross weight[e]	60	60	60
Chromium, chromite gross weight[e] thousand tons	590	610	600
Columbium-tantalum minerals, tantalite, gross weight[e]	40	40	40
Copper:			
Mine output, metal content	[2]39,491	[2]31,723	[e]33,000
Metal, primary:			
Smelter[e]	[r]30,000	23,500	28,000
Refined[e]	[r]27,000	23,500	28,200
Gold, mine output, metal content[e] thousand troy ounces	800	600	600
Iron and steel:			
Iron ore, gross weight[e] thousand tons	600	600	550
Pig iron[e] do.	300	300	320
Ferroalloys, ferrochromium[e] do.	180	185	100
Crude steel[e] do.	300	350	350
Nickel:			
Mine output, metal content[e]	10,000	16,000	13,000
Smelter[e3]	9,000	10,000	13,000
Silver, mine output, metal content[e] thousand troy ounces	[4]169	[4]117	114
Tin:			
Mine output, metal content[e]	600	600	600
Smelter[e]	600	600	600
Tungsten, mine output, metal content[2]	[5]38	[e]25	[e]25
NONMETALS			
Asbestos[e] thousand tons	165	165	200
Cement, hydraulic do.	677	540	492
Fertilizer materials, crude phosphate rock do.	180	130	140
Fluorspar[e]	180	200	200
Lithium minerals, gross weight[e6]	[r]15,000	9,000	9,000
Magnesite[e]	20,000	20,000	20,000
Pyrite, gross weight[e] thousand tons	75	75	75
Sulfur:			
Content of pyrite[e] do.	30	30	30
Byproduct of coal and metallurgy[e] do.	2	3	3
Total[e] do.	32	33	33
MINERAL FUELS AND RELATED MATERIALS			
Coal, bituminous[7] thousand tons	2,581	2,926	2,197
Coke, metallurgical do.	[e]270	[7]227	[7]194

[e]Estimate. [p]Preliminary. [r]Revised.

[1]In addition to the commodities listed, modest quantities of unspecified types of crude construction materials (including clays, stone, sand and gravel) were produced, but output is not reported quantitatively and available information is inadequate for the formulation of reliable estimates of output levels. Also, natural corundum, graphite, and mica have been produced in the past and output presumably has continued, but no basis for estimates of output levels is available. Through 1965, annual corundum output was at a level of several thousand tons, ranking Southern Rhodesia second only to the U.S.S.R.

[2]Data are for years ending September 30 of that stated.

[3]Includes nickel content of nickel oxide and nickel fonte.

[4]Output of Inyati mine only.

[5]Output of Beardmore mine only.

[6]Data represent only an approximate order of magnitude.

[7]Data represent sales for years ending Aug. 31 of that stated.

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COMMODITY REVIEW

METALS

Chromite.—Restrictions have been placed on dissemination of information on the Rhodesian chromium industry since the 1965 UDI, and no official production figures have been available since. Although information about reserves was also mostly out of date, recent estimates were put at greater than 1 billion tons, up from the 608 million tons of chromite estimated in 1960.[5] Over 500 million tons were estimated to be high-chromium chromite, and Rhodesia was still considered as one of the major sources of metallurgical-grade chromite in the world. Recent estimates indicated that Rhodesia produced about 6% of the total world output and ranked second in world chromite reserves.

The most important factor influencing Rhodesia's chromium industry over the last 10 years was the imposition of economic sanctions by the United Nations Security Council in December 1966. The United States imposed sanctions in January 1967 but by November 1971, with passage of the Byrd Amendment, had made exceptions to the sanctions including chromite. Attempts to reimpose U.S. sanctions against imports of Rhodesian chromite and other essential minerals were successful on March 16, 1977, when the Byrd Amendment was repealed by Congress.

The renewed U.S. import ban and the closing of the Mozambique-Rhodesia border in 1976, which had effectively sealed the traditional route for chromite export, resulted in Rio Tinto (Rhodesia) suspending its chromite operations by 1978, including a pilot ferrochrome smelter in the Rhodesian Midlands. Rio Tinto, which operated the Mtorashanga and newer mines near Selukwe, also experienced heavy losses at the company's nickel properties, and 1977 profits were down by 16%.[6] Early in the year, the Rhodesian Chamber of Mines indicated that 1977 chromite mine output might exceed that of 1976. By yearend, however, Rhodesian ferrochrome and chromite sales were beginning to reflect both the effects of a weak world chrome market, as well as stringent U.S. enforcement of sanctions.

Copper.—MTD (Mangula) Ltd., a member of the Messina (Transvaal) Development Co. Ltd. (MTD) group of companies, reported total copper metal production for 1977 at 15,073 tons. For the 6-month period ending April 31, 1978, a total of 934,200 tons of ore was milled at the Miriam and Norah mines in the Mangula complex, with recoverable copper amounting to 7,979 tons. The Silverside mine showed no production. This compares with the 6-month period ending April 31, 1977, when 877,200 tons of ore were milled with total recoverable copper of 6,616 tons. The Silverside contributed 92,800 tons, with 546 tons recoverable copper, to the early 1977 figures. MTD (Mangula) reported its profits after taxation were $5.6 million in 1977 compared with $9.6 million for 1976. This drop in profits was attributed to low-grade ore encountered at the Miriam and Norah shafts, lower copper prices, and the late commissioning of concentrator improvements. At Miriam, the ore grade fell to 0.93% copper, which when budgeted against the expected grade of 1.08% copper, resulted in a short fall production of 1,900 tons.

At yearend, MTD was planning to expand its copper output by 30% or more, despite the depressed world copper market. The completion of two concentrator extensions at the Mangula and Norah mines made it possible to increase output by 4,900 tons per year. In 1977, MTD's mining costs per ton was $796 and was below the average price ($1,250 per ton) that the company managed to obtain for its copper exports.[7]

MTD's Copper Queen mine (also known as the Sanyati mine), located 90 kilometers west of Sinoia, was reported to have ore reserves totaling 15 million tons with 1.4% copper, 1.35% lead, and 1.85% zinc. Although the grade and size of reserves were good, the ore bodies occurred in a highly folded and structurally complex environment that would make dilution of mill feed unavoidable. Viewed with the recent decline in copper, lead, and zinc prices, Messina Rhodesia Investments Ltd. was deferring the mine's development.[8]

Corsyn reported that although gold revenues had improved during 1977, profits from copper derived from the Inyati mine were down. Ore reserves at the mine dropped from 809,000 tons to 692,000 tons.[9] By yearend, Inyati's milling rate had been reduced by 50%. Ore reserves at the Muriel mine also declined from 316,000 tons to 270,000 tons, reflecting the unpayability on the lower levels of the Main and Pink reefs.

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The MTD option to purchase the Ayrshire mine was dropped.

Gold.—Falcon Mines Ltd. reported that the Dalny mine milled 238,500 tons of ore, which yielded 7.64 grams (0.25 ounce) of gold per ton for a total of 1,822 kilograms (58,579 troy ounces) of gold for the financial year ending September 30, 1977. Net profit at the Dalny mine was $2.1 million. The tonnage milled was 1,600 tons less than the target figure because of plant breakdowns during the year, but this was made up by a higher recovery grade. Working costs were 4% higher than anticipated. Ore reserves at September 30, 1977, were estimated at 1,118,000 tons with an average grade of 11.9 grams (0.38 troy ounce) per ton over a width of 172 centimeters. The three mines of Falcon's subsidiary, Olympus Consolidated Mines Ltd., were interrupted by serious flooding by early 1978, which could not be brought under control during the first quarter of the year. Development results had been satisfactory at all mines except at the Dawn mine where future ore reserves were tenuous.[10]

The Coronation Syndicate Group (Lonhro Investment Group) operated the Arcturus, Mashona Kop, Mazoe, and Muriel mines. The subsidiary, Corsyn Consolidated Mines Ltd., owned the Arcturus which was one of the country's leading gold producers, employing 30 Europeans and 700 Africans. The success of the last decade was the result of Arcturus' 10-level cross-cut extensions which were pushed through during what were thought to be the last months for the mine. Intersection of the Venus Reef ore by this exploration effort laid the foundation for additional reserves that were expected to last for the next decade.[11] Ore reserves at the Muriel gold and copper mine dropped from 316,000 to 270,000 tons because of unpayability on the bottom levels of the main ore bodies. Total Corsyn gold production was 2,222 kilograms (71,439 troy ounces), compared with 2,315 kilograms (74,429 troy ounces) in 1976. Byproduct gold from Corsyn's Inyati and Muriel copper mines added about 26,000 ounces to this total.

The Rio Tinto group was reworking the old Cam and Motor mine dump and was seeking to reopen the Renco gold mine. Falconbridge Nickel Mines Ltd.'s (Canada) subsidiary, Ventures of Africa Ltd., was producing approximately 18,000 ounces per year from the operations of Blanket Mine (Pvt.)Ltd., including workings from the old Feudal mine.

Iron and Steel.—Additional high-grade iron ore reserves were discovered on the Rhodesian Iron and Steel Co. Ltd.'s (RISCO) Buchwa claim that were expected to extend the steel company's mining life in this area by at least 2 years. RISCO's current iron ore reserves at Buchwa are now expected to last about 17 years at present rate of production. The Buchwa mine supplied RISCO's steelworks at Redcliff. After the extensive expansion in 1976, a large part of the steel plant's output was exported. In 1977, however, RISCO was affected by world recession in the steel market, as well as by the local reduction in demand. Government grants and loans to assist the company through the recession amounted to $20 million. The Government also proposed to raise its stock holding in RISCO from 10.9% to 49.74% of the equity. This money ($13.6 million) was to be used as working capital. The other shareholders were also offered increased equity.[12]

Nickel.—By yearend 1977, Johannesburg Consolidated Investment Co. Ltd.'s (JCI) Shangani nickel mine had cut back its operations by about 50% to limit expenditures and bring production back into line with sales. In order to stop rising of mine costs, mining was discontinued in the lower grade West Pit, and the rate of waste stripping in the East Pit was reduced. A decision to reduce mill throughput was made in October. Earlier, for the year ending June 1977, the tonnage milled had been increased to 1,219,000 tons, compared with 418,000 tons in 1976, to compensate for lower than expected nickel recoveries. Production from the pit also had been accelerated above 500,000 tons per month in order to reduce overhead and enable JCI to withdraw from the pit where walls were deteriorating. A total of 6,380,000 tons of ore and overburden were hauled from the open pit, compared with 6,450,000 tons in 1976. Shangani (owned 49% by JCI) had a net loss for the year ending June 1977, amounting to $3.5 million, which when added to the loss brought forward, gave an accumulated sum of nearly $9.6 million. JCI borrowed $14.4 million to finance increased stockpiling, and by early 1978, nickel stocks were built up to 550 million pounds.[13] By yearend 1977, over 100 of the total 440-person work force were laid off. Most world producers had cut back production as the soft nickel market continued, and the future prospects for Shangani looked bleak.

Rio Tinto operated the Empress mine; the Perseverance mine's operations were sus-

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pended since 1975. Whereas in 1976 most of Rio Tinto's profit came from the Empress, by 1978, the first quarter profits from the Empress had slumped by 51% because of depressed nickel and copper markets.[14]

Anglo American Corp. completed exploratory drilling in 1977 with low-grade nickel deposits discovered. By July, the company announced withdrawal of its geological team and suspension of its prospecting activities in Rhodesia. Through its subsidiary, Rhodesian Nickel Corp. Ltd. (Rhonick), Anglo operated the nickel mines at Trojan and Madziwa in the Bindura/Shamva area and the new Epoch mine at Filabusi, as well as the Bindura smelter.

Rhonick reported that the amount of ore milled at the Trojan mine was higher in 1977, and in spite of a lower grade, the production of nickel in concentrate was the highest ever achieved by the mine. The average production rate at the Epoch mine mill was 35,000 tons per month. Plant and underground mining capacity had been extended in 1976 to increase the milling rate from 25,000 tons per month. Improvements were made in the metallurgical recovery along with minor plant modifications and careful operation. This resulted in the nickel in concentrates being 40% higher than last year. The tonnage at the Madziwa mine was only marginally above that milled in 1976. The Madziwa ore bodies were extremely erratic and complex. The random distribution of high-grade ore, together with complex ore body structure, resulted in a greater dilution of ore with waste rock. Refinements to the mining method were being continuously pursued in an attempt to increase the nickel content above 0.60%. An increase in security commitments had placed a very heavy load on the staff with up to 25% of the employees absent from time to time.[15]

Tin.—Kamativi Tin Mines Ltd. announced improved profits for the year ending December 31, 1977, and a dividend of 10% was paid.

Uranium.—Early in 1977, five exclusive prospecting areas for uranium in the Kariba Lake area were being searched by the firm Prospecting Ventures Ltd., an Anglo American Corp. subsidiary. Deposits discovered 30 years ago near Binga were considered too small for development. By July, however, Anglo had announced withdrawal of the prospecting team from the area owing to the deteriorating security situation there.

NONMETALS

Asbestos.—Rhodesia's asbestos output was estimated to be about between 200,000 and 350,000 tons per year. Official statistics on the industry were not available. The largest producer was the Rhodesian and General Asbestos Corp. (Pvt.) Ltd., which operated the Shabanie, Gaths, Temeraire, and King mines in the Shabani and Mashaba districts. The company also held mining leases at Crown Land in Victoria. Pangani Asbestos Mines (Pvt.) Ltd. operated the Pangani mine near Bulawayo, the Vanguard mine near Gwelo, and the Boss mine near Victoria. Kudu Mines (Pvt.) Ltd. operated the Kudu mine and the two Wynnes mines near Bulawayo. In addition, A. D. Theron and Sons (Pvt.) Ltd. operated the Thornwood mine near Bulawayo; D.S.O. Asbestos (Pvt.) Ltd. operated the DSO mine at Crown Land, Victoria; and the Elenem Syndicate operated the Sihande mine in Gwelo. Milling and grading facilities process a high proportion of spinning fibers and a wide range for use in the manufacture of asbestos cement. Some was processed at Turner and Newall's asbestos cement plants in Salisbury and Bulawayo in Rhodesia, in Durban, South Africa, and Lusaka in Zambia. The main asbestos cement manufacturer in Rhodesia was Turnal Ware Sales of Salisbury.

Barite.—Barite produced for the local paint and glass manufacturing industries was estimated to be about 100 tons per year. Production was from four mines including the Dodge mine near Shamva (in operation since 1949)., the Argosy mine near Que Que and the Dick Mick and Staff mines near Bulawayo. Rhodesia was estimated to have barite ore reserves in excess of 500,000 tons.

Cement and Limestone.—Three cement plants were producing in 1977. United Portland Cement Co. (Pvt.) Ltd. had one plant at Bulawayo with a 210,000-ton-per-year capacity and another at Colleen Bawn with a 255,000-ton-per-year capacity. The Salisbury Portland Cement Co. Ltd. operated a 120,000-ton-per-year plant at Manresa, Salisbury. Limestone used in the manufacture of cement was quarried at Colleen Bawn near Gwanda and at Sternblick and Salisbury. Agricultural limestone was also produced at a number of localities, but the principal firms quarried Lomagundi dolomites near Sinoia.

A limestone quarry at Redcliff, near Que Que, produced metallurgical—grade lime-

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stone for the steel industry. The flux requirements of the copper and nickel industries were being furnished by the Early Worm Mines near Concession and the Dodge mine northeast of Salisbury.

Corundum.—Production and trade patterns for natural abrasives changed little during 1977, although worldwide demand for both natural and synthetic types improved significantly. Of the total 1977 world mine corundum output of 11,500 tons, Rhodesia was estimated to produce about 2,700 tons.[16] Rhodesia was considered to be the world's second largest supplier of corundum, after the U.S.S.R. Most (97.8%) of the corundum produced in Rhodesia was the "boulder" or massive cryptocrystalline variety, although some crystal corundum was also produced. Most of the corundum was derived from the O'Briens Claims, located on the Somerset Farm near Concession, about 56 kilometers northwest of Salisbury. The Rhodesian Corp. Ltd. had been mining these claims continuously since 1953. Between 1953 and 1965, an estimated 36,000 tons of natural "boulder" corundum had been produced. Total ore reserves at the O'Briens Claims were estimated at 52,000 tons including 30,000 tons eluvial corundum; a minimum of 1,800 tons granulite corundum at the Central Quarry deposit, estimated to a depth of 15 meters; and 18,000 tons at the South Quarry deposit, estimated to a depth of 10 meters. Corundum has also been produced from deposits located in Belingwe, Corundum Eastland Rank, and the eluvial deposits at Weluzani.[17]

Diaspore.—In the vicinity of Wankie, diaspore nodules occur in lenses up to 3 meters thick in the Pleistocene gravels making up the erosional surface on gneiss. Diaspore nodules extracted from these gravels at the Van Beck Claims, situated on Nuanetsi Ranch on the eastern side of a Bumburudza River tributary, were being used as a flux by the ferrochrome industry.

Fluorite.—About 200 tons of fluorite was produced in 1977 for use in local foundries. The main deposit was located at Tinde Fluorite, owned by Matabeleland Exploration Co. (Pvt.). The deposits occur on northeast fault zones related to the Zambezi Trough in the vicinity of Kamativi. Tinde Fluorite was estimated to have reserves of about 200,000 tons.[18]

Magnesite.—Magnesite, produced mostly for export and used in chrome-magnesite bricks, was being produced from the Barton Farm magnesite deposit, operated by Refractory Minerals (Pvt.) Ltd. and owned by Vereeniging Refractories. The Pande mine near Beitbridge and the Calac occurrence of the Nuanetsi district were both dormant. The Barton Farm deposit was considered unique in being sedimentary in origin and Archaean in age and was compared with the magnesite horizons of the Adelaide System of South Australia. Open pit methods were initially used, but this has been superseded by underground mining.

Mica.—Mica was being produced from the pegmatites of the Miami district, located 32 kilometers northeast of Karoi. Pegmatites, with commercial quantities of mica, occur in an area running from the Mozambique border through Mount Darwin and the Urungwe area to Kariba Lake, but the most abundant area occurs near Miami. Mitmar (Pvt.) Ltd. was operating several mines in the Salisbury district near Karoi.[19] Lomagundi Mining (Pvt.) Ltd. was operating a mine and grinding plant with a 2,000-ton-per-year capacity of minus 1/2-inch mica flakes. Bruna Minerals Exploitation (Pvt.) Ltd., an associate of Messina Mica (Pvt.) Ltd., operated the Ubique/Rhuwesa mine at Wankie with an annual capacity of 2,500 tons per year. A variety of mica products including heating elements, drilling mud flakes, stamping, and waste for the electrical industry were also being produced. The Rhodesian vermiculite industry was dormant. About 1,000 tons of both wet and dry ground mica was used locally by the paint and rubber industries.[20]

Quartz/Silica.—Quartz was being produced at the Japempi Block mine in Bulawayo district, at the Broadside, Duzi, and Ruth mines of Gwelo district, and the Chiten, Patronage, Todoma, and Rubeni mines of the Salisbury district.[21] Lomagundi Smelting & Mining (Pvt.) Ltd., at Sinoia, was producing 12,000 tons per year for use in copper smelting. The Lone Kop deposit, located near Hartley, was estimated to contain 3 to 5 million tons of high-grade (+98%) silica and has not been exploited. Most industrial requirements, including those of the ferrochrome industry, are met by the mines of the Gwelo district. Ground silica, produced near Salisbury, was being used in the manufacture of enamel.[22]

MINERAL FUELS

Coal.—The Industrial Development Corp. (IDC) was completing investigations into oil-from-coal processes. Reports indicated the

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country could not now, or in post-sanctions situations, afford an oil-from-coal plant in the scale of South Africa's SASOL plant. A first-stage plant of modest proportions was suggested as more suitable to Rhodesia's needs and resources. Additional capacity could be added later on a modular basis as funds and overseas expertise became available. IDC was also involved in a joint investigation with the Bulawayo Municipality into the feasibility of producing gas, liquid fuels, and other byproducts from Wankie coal. IDC was also granting funds to RISCO to enable the benzol plant at Redcliff to be overhauled and recommissioned. Until late 1975, this plant was producing benzol as a byproduct of the coking plant. Production was expected to recommence in early 1979.[23] The Government was also studying a scheme to convert maize into fuel to reduce gasoline imports.

Recent exploration by IDC had located coal resources of about 700 million tons in the Lubimbi and Gwasi areas, located 75 kilometers southeast of Wankie; the coal and bituminous shales had an average ash content of 50%. Some 350 million tons had an average content of 27%, all of which could be extracted by open pit methods. The coal in the Lubimbi/Gwasi areas did not contain clearly defined coal seams and was a thick body of intercalated coals and bituminous shales that would require washing treatment. It was estimated that for every 100 tons mined, 10 tons would be recoverable as high-quality coking coal of 10% ash content, and about 50 tons would be waste shale of 73% ash content.[24]

The total size of Rhodesia's coal reserves were unknown. Rhodesia, well endowed with coal, was estimated to have 11% of the total known coal reserves on the African continent. Current estimates indicated that Rhodesia's coal reserves were sufficient to see the country through the next 200 years or longer. Unexploited reserves at Wankie were believed to be in the order of 2,250 million tons, while resources in other parts of the country had been assessed at about 5,080 million tons. Definitive figures varied, however, with one estimate indicating a total probable reserve of some 2,500 million tons, of which only 750 million tons were extractable. Of this amount, 59% was considered low-ash coal suitable for coking and the rest suitable for steam coal. In addition, there was a possible reserve of 5 billion tons of lower grade coals and carbonaceous shales.

The No. 4 colliery at Wankie was closed and put on a care-and-maintenance basis in late 1977 because of a drop in coal sales. Sales for the year ended August 31, 1977, had dropped by 20% to 2.2 million tons. All market requirements were being met by the No. 3 colliery and the open pits. Production at the No. 4 colliery had been 61,500 tons in August, but coal sales had dropped because of the continuing general decline in the economy. Wankie employed about 5,300 Africans and 500 Europeans.

Coke ovens at Wankie were to be operated at a minimum, but active coke exports were expected to reduce Wankie's large coke stockpile. Coal sales by Wankie Colliery Company Ltd. for the year ended August 31, 1977, fell 25% to 2,197,000 tons, while coke sales at 194,000 tons were 14% less than in 1976. At yearend, an agreement was reached for a 10% price increase for all of the company's products.[25]

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Southern Rhodesian dollars (R$) to U.S. dollars at the rate of R$1.00=US$1.60.

[3]Ministry of Finance, Government Printer. Economic Survey of Rhodesia Salisbury, July 1978, 23 pp.

[4]Mining Annual Review-1978 (London). Rhodesia. pp. 477-478.

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[18]Page 102 of work cited in footnote 17.

[19]Mining in Rhodesia 1977 (Salisbury). Rhodesia, Schedule of Operating Mines. P. 71.

[20]Page 103 of work cited in footnote 17.

[21]Mining in Rhodesia 1977 (Salisbury). Rhodesia, Schedule of Operating Mines. Pp. 59, 65, & 71.

[22]Page 105 of work cited in footnote 17.

[23]The Rhodesia Herald-Business Herald (Salisbury). Oil From Coal Process Needed. Aug. 31, 1978, p. 1.

[24]Chamber of Mines Journal (Salisbury). IDC Rates Oil-From-Coal Top Priority Project. V. 19, No. 10, October 1977, p. 28.

[25]Anglo American Corp. of South Africa Ltd. 61st Annual Report 1978. P. 28.

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The Mineral Industry of Romania

By George Rabchevsky[1]

Even though Romania has many natural resources, by almost every economic indicator it is still one of the less developed countries. Among East European countries, Romania is second only to Poland in area and population and has long been a major European producer of oil, and more recently, natural gas. The current 5-year plan (1976-80) places heavy emphasis on the development of the chemical industry, which is slated to grow at an annual rate of 15%.

In spite of the severe damage ($2 billion) caused by the March 4, 1977 earthquake, the overall economic performance in 1977 registered a 14% increase instead of the 11% stipulated by the plan. Not unexpectedly, numerous projects were delayed or postponed as a large proportion of the available funds had to be reallocated for reconstruction work. The disaster had especially placed an added strain on the already tightly stretched building materials industry.

A further problem was the acute shortage of trained workers, particularly for the high technology industries, so that labor productivity remains low by both Western and East European standards. In 1977, large groups of workers in Romania began receiving increases in salaries. The wages were increased in two stages: The first stage began on July 1, 1977, and the second stage will start September 1978. In the mining industry, for example, the wages were increased 20%, the highest percentage for the entire economy, while the pay for machine and metal workers was raised by 18%. During the 5-year plan, the total wage increase in those two sectors was 35% and 31%, respectively. The pay increase for ferrous metallurgical and coking chemical industry amounted to 19% in the first stage and to 33% for the remaining 5-year period. In the mining industry, a miner with a net monthly base pay of 3,000 lei[2] receives a 750 lei monthly raise during the first stage. In the ferrous metallurgical and coking chemical industry, the pay increases in the first stage ranged from 265 to 504 lei for skilled workers and from 196 to 280 lei for unskilled workers.[3]

One of the most pressing problems of the Romanian economy is reducing consumption of energy and raw materials, so that its natural resources could be preserved. For example, in 1938 Romania produced 284,500 tons of steel and the availability of iron ore and coke were considered sufficient. But by 1975, even though extraction of iron ore had increased to more than 3 million tons, it was far from satisfying the need of the steel industry, resulting in increased imports. The need for more imports is also evident for other raw materials such as nonferrous metals, crude oil, and others. Romania, therefore, initiated a conservation program of its own, long before the rise of the worldwide energy crisis.

The 1977 plan stipulated annual investments worth 181 billion lei,[4] but actual investments in 1977 fell short of target and reached a level of 169 billion lei. Romanian investments in 1977 in the various industries are shown below (in billion lei):

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Industry/sector	Planned	Actual
Agriculture	21.2	23.8
Construction	5.0	10.7
Education - culture	6.4	3.0
Housing	18.8	16.5
Industry	96.5	80.7
Scientific research	1.2	1.2
Trade	5.1	5.4
Transportation - communication	16.2	17.5
Total, industry sector	170.4	156.8
Total, all sectors	180.5	169.0

In 1977, a large number of new ministers and minister-secretaries of state were appointed, the leadership of the entire judicial establishment was reorganized, and one-fourth of the country party first secretaries were assigned different positions.

Government Policies and Programs.—Romania's 1978 plan provides for higher growth rates in all main areas of the economy, industrial and agricultural output, industrial investment, and foreign trade turnover. According to the Grand National Assembly, the overall industrial production in 1978 is to total 822 billion lei. In 1978, the estimated number of workers in the economy will total 7 million and the 1978 national income is to be 500 billion lei. In 1978, the volume of foreign trade is to amount to 82 billion lei. Thus, despite certain problems, especially the acute shortage of skilled labor and the lack of adequate energy resources, the outlook for the economy remains relatively favorable.

The following 1978 production levels are planned for selected commodities:

Commodity	1978 production goals
Electric power, million kilowatt-hours	64,510
Net coal, thousand tons	36,440
Extracted crude oil, do.	15,100
Extracted methane gas, million cubic meters	26,830
Steel, thousand tons	12,070
Primary aluminum and aluminum alloys, do.	210
Industrial machinery and technological equipment, million lei	15,300
Chemical fertilizers[1], thousand tons	3,100
Cement[2], do.	16,200

[1]Equivalent of 100% active substance.
[2]Equivalent of 80% clinker.

According to the plan, in 1978 the total volume of investment in the national economy will be 213 billion lei. The industry's portion of this investment (which includes drilling equipment) will be 118 billion lei and 2 billion lei are allocated to scientific research and technological development; some 2.4 billion lei was slated for investment in environmental protection. The Council of Ministers further stressed that in 1978 the industry should strive to make greater use of substitute materials, utilize more secondary materials and scraps, and accelerate the utilization of purchased licenses and developing technologies on the basis of licenses already in production.

Important investment increases in 1978 are again envisaged for the Ministry of Mines, Petroleum and Geology (7 billion lei); and for the Ministry of Metallurgical Industry (6 billion lei). Funds to the former Ministry are allocated for the improvement of production at the lignite mines in Oltenia; for the Petrila coal processing unit; for the additional mechanization of coal mining in Jiu Valley; for the opening of the Cimpulung-Sud lignite pit and the Petrila-Sud mine; for the opening of the Coranda Hondol Complex iron ore deposits; for the Valea Morii copper ore deposits, including those in Hunedoara, Baia de Arama, and Mehedinti Counties. Investment funds to the Ministry of the Metallurgical Industry are provided for the continuation of work at the Calarasi iron and steel plant, for the improvement of coke production at the Galati iron and steel plant, for the development of block and pillar forgings at the Tîrgoviste combine for special steel, for development of sections of welded drill pipe coupling and tubing for deep drilling at I.T. Republica, for the Drobeta Turnu Severin small-section rolling mill, and for the Otelul Rosu medium and special section rolling mill. The ministry of electrical power is budgeted for the work on district stations operating on coal in Calafat and Timisoara, for the Runcu-Firiza hydropower station, and for the continuation of work at the Craiova II power station. Other projects, began in 1977 as part of the sixth 5-year investment plan and still being constructed, are the hydroelectric power stations on the Danube, the Irongates II-Gruia Station, on the Olt River in the Turnu-Calimanesti region, and on the Sebes River at Sascior and Petresti.

It is also planned to intensify geological prospecting and exploration work for the location of new industrial mineral resources, especially crude oil, natural gas, and ferrous and nonferrous ores; a better exploitation of the low-grade iron and copper ores; and raising the index of recovery of crude oil.

According to Dr. Engr. Elena Ceausescu,

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research will be stressed on producing nonferrous metals through the utilization of native ores and the extraction of rare earths to meet the needs of the electronics, nuclear power, and aerospace industries. In addition, output of ammonia soda, barium salts, and sodium dichromate is to be raised 80% to 90%. In the field of mineral fertilizers, research will be undertaken on the diversification of combined and compound fertilizers and liquid fertilizers.[5]

In the next 5-year plan, industrial production is expected to rise by 55% to 60%, so that by 1985 industry will be contributing almost 70% (56% in 1976) to the total national income. In the mining industry, special attention is to be devoted to the expansion of domestic raw materials and energy. Iron ore will continue to be extracted from the known rich deposits but lower grade deposits will also be mined; for example, at Palazu Mare-Constanta. An intensified mining effort of the cupriferrous ores is to be initiated in Maldova Noua, Roşia Poieni, and Valea Morii. A more efficient exploitation of the bauxite reserves using improved technologies, is also planned. The industrial uses of potassium salts and titaniferrous alluvium, and the accelerated development of sulfur production are also proposed. Techniques are to be developed for the extraction and preparation of siliceous ores of manganese and serpentines and for the recovery of vanadium from iron ores, and molybdenum from the cupriferrous concentrates. Some of the existing metallurgical plants are to be enlarged to increase production capacity for pig iron, crude steel, and rolled steel. For example, renovation is to be initiated at the Calarasi iron and steel combine, the construction of which began during the current (sixth) 5-year plan. Quality steels will begin to be manufactured, including stainless and high-melting steels, and super-strong rolled steels and pipes.

Various types of equipment and machinery in use by the mining industry are to be improved and expanded, such as the equipment for metal processing, iron-rolling mills, pipe and wire mills, and the introduction of electric and large capacity furnaces. Crude oil refineries are to be built capable of catalytic gasoline reforming, hydroforming of diesel fuel, hydrocracking, and catalytic cracking. The oil tanker fleet and equipment are also to be expanded in line with the refineries' increased capacities. Besides the added oil tankers, high-tonnage ore barges and storage tanks are also to be built to take care of the anticipated domestic and export transportation needs.

The search for new energy resources will include deep oil and gas drilling on land, the exploration of the Black Sea continental shelf, the improvement of crude oil recovery techniques, and the increase in production of coal. Underground gasification of coal and oil shale are also planned. By 1985, coal and oil shale are to constitute 50% of the fuels used for the generation of energy and 20% of that energy is to be generated by water power. New hydroelectric plants are to be built along the Danube and other waterways. The construction of nuclear powerplants is also to be stepped up, so that eventually the utilization of hydrocarbon fuels will be at the minimum.

The chemical industry will continue to be one of the most vital industries in Romania in 1985. In addition to oil-processing expansion, the petrochemical industry will attempt to produce plastics that will replace metals, thus easing natural raw material usage. The production of chemical fertilizers is also to be increased. An increase in utilization of halite, sulfur, and potash is envisaged, together with the manufacture of new products such as magnesium oxide, titanium pigments, potassium, nickel, and cobalt salts.

In addition to fuel and materials conservation and improved technological measures, the 5-year plan also stresses the recovery of secondary products and processing of wastes, and the preservation of the environment. The support and implementation of scientific research and technological development in the seventh 5-year plan are to exceed the level of the current 5-year plan by about 50%, employing more than 180,000 persons by 1985, of which 65,000 are to be in high-level research. To implement the goals of the seventh 5-year plan (1981-85), Romania will have to make an investment 1.4 times that of the 1976-80 period.

PRODUCTION

To achieve the goals of the current 5-year plan, special attention was paid in 1977 to the utilization of scrap, which was expected to make up 30% to 40% of Romania's total

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raw material requirements; instead a 42% level was achieved. The 1977 consumption (in tons) of some selected commodities is shown in the following table:[6]

Commodity	Production	Consumption
Aluminum	209,000	140,000
Copper (refined)	48,000	60,000
Lead (refined)	41,700	45,000
Nickel	NA	6,000
Tin	NA	3,200
Zinc (smelter)	51,860	45,000

NA Not available.

The actual total value of 1977 Romanian production was 754 billion lei, instead of the 735 billion lei originally set in the 1977 plan. However, the data also show that 63% of the targets were unfulfilled, several were of major significance. The following table compares the original 1977 plan figures with the actual achievements for some of the commodities where targets were not met.[7]

Commodity	Production, 1977	
	Actual	Planned
Electric power, million kilowatt-hours	59,858	63,110
Coal (mined), thousand tons	29,144	33,530
Crude oil, do.	14,650	14,850
Steel, do.	11,457	11,695
Rolled steel, do.	8,392	8,708
Lead (refined), tons	41,700	47,600
Zinc (smelter), do.	51,860	55,400
Chemical fertilizers, thousand tons	1,981	2,882

The devastating earthquake that struck Romania may only partially be blamed for the lag in production. However, the production of chemical fertilizers was hindered by the serious quake damage to the petrochemical plants in Turnu Magurele and Teleajan.

Conservation of raw materials by the industry continued to be stressed in 1977. According to Romanian media, an increase of 1% in the volume of processed scrap could provide about 150 million lei of additional raw materials per year for the economy as a whole. In 1977, the utilization of scrap metal made up about 42% of the entire steel production, 37% of domestic copper production, and 32% of lead production. Metallurgical slag was also processed for its iron (about 100,000 tons), while the remainder was used as construction material. In the manufacture of cement, for example, in addition to slag, wastes were used from gypsum phosphates, concentration tailings, and ashes.

In 1977, 535 production projects were put into operation, of which 491 were industrial. At the Galati iron and steel works, a coke plant, cold- and hot-rolling steel mills, and a magnesium lime block plant were put into expanded production. Production capacities were also increased at the Resita iron and steel combine and at the Tîrgoviște special steel complex. The No. 2 pipe mill at the Roman Pipe Enterprise was put into production, as was a special sections mill at the Otelul Rosu Enterprise; and a casting foundry at the Vlahita Iron Works was put into production. New production facilities were installed at the Baia-Mare mining equipment enterprise and new alkyl-phenol and ammonia installations began producing at the Brazi petrochemical combine. Expanded production of ammonia began at the Arad, Craiova, and the Turmu Magurele fertilizer plants. And, finally new types of cement began to be produced at the Hoghiz and Mintia complexes, with new units capable also of prefabricated concrete manufacture started in Bistrita, Bucova, Iasi, and Bucharest.

Table 1.—Romania: Production of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Aluminum:			
Bauxite, gross weight	[r]779,000	890,000	900,000
Alumina, gross weight[e]	[r]420,000	450,000	430,000
Ingot (including alloys)	204,000	207,000	209,000
Bismuth, mine output, metal content[e]	80	80	80
Cadmium, smelter output[e]	[r]100	100	90
Copper:			
Mine output, metal content[e]	[r]27,000	28,000	27,000

See footnotes at end of table.

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Table 1.—Romania: Production of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
METALS —Continued				
Copper —Continued				
Smelter:				
Primary		31,000	32,000	31,000
Secondary		5,000	5,000	4,000
Total		r36,000	37,000	35,000
Refinery, primary and secondary		r38,000	38,000	40,000
Gold, mine output, metal content[e]	troy ounces	60,000	60,000	65,000
Iron and steel:				
Iron ore	thousand tons	3,065	2,835	2,467
Pig iron[3]	do.	6,602	7,415	7,784
Crude steel	do.	9,549	10,733	11,457
Semimanufactures:				
Castings and forgings, finished	do.	898	e950	e1,000
Pipes and tubes	do.	1,151	1,216	1,320
Rolled products	do.	6,810	7,305	8,392
Lead:				
Mine output, metal content		r33,000	35,000	35,000
Smelter, primary and secondary		r31,000	32,000	32,000
Manganese:				
Ore:				
Gross weight[e]		r80,000	80,000	80,000
Manganese content[e]		r17,000	17,000	17,000
Concentrate, gross weight		r28,000	e28,000	e28,000
Silver, mine output, metal content	thousand troy ounces	r1,190	1,220	1,125
Zinc:				
Mine output, metal content		r67,000	67,000	62,000
Smelter, primary and secondary		r60,000	60,000	55,000
NONMETALS				
Barite		r e80,000	r e85,000	e85,000
Cement, hydraulic	thousand tons	r12,019	13,088	13,875
Clays:				
Bentonite		62,800	63,000	63,000
Kaolin		87,400	90,000	90,000
Diatomite[e]		40,000	40,000	40,000
Feldspar[e]		58,000	58,000	60,000
Fertilizer materials, manufactured:				
Nitrogenous, N content	thousand tons	1,292	1,331	1,381
Phosphatic, P_2O_5 content	do.	404	493	548
Fluorspar[e]		15,000	15,000	20,000
Graphite[e]		6,000	6,000	6,000
Lime	thousand tons	3,064	3,320	3,447
Pyrite, gross weight[e]	do.	870	870	915
Salt:				
Rock salt	do.	NA	NA	NA
Other	do.	NA	NA	NA
Total	do.	3,833	4,210	4,535
Sand[e]	do.	1,200	NA	NA
Sodium and potassium compounds:				
Caustic soda	do.	566	673	735
Sodium carbonate, manufactured, 100% Na_2CO_3 basis	do.	693	814	861
Sulfur:				
Content of pyrite[e]	do.	375	375	395
Byproduct, all sources[e]	do.	90	98	110
Total[e]	do.	465	473	505
Sulfuric acid	do.	1,448	1,555	1,523
Talc[e]		60,000	60,000	60,000
MINERAL FUELS AND RELATED MATERIALS				
Carbon black		86,447	91,282	100,433
Coal:				
Run-of-mine:				
Anthracite and bituminous	thousand tons	8,809	8,696	8,637
Brown	do.	660	600	635
Lignite	do.	19,916	18,819	19,872
Total	do.	29,385	28,115	29,144
Washed (produced from above):				
For coke and semicoke production	do.	1,845	1,924	2,154
Lignite	do.	19,155	18,164	19,028
Other (unspecified)	do.	6,091	5,754	5,596
Total	do.	27,091	25,842	26,778

See footnotes at end of table.

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Table 1.—Romania: Production of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS —Continued			
Coke, metallurgical ---- thousand tons	2,277	2,472	3,148
Fuel briquets (from brown coal) ---- do	236	NA	NA
Gas:			
Manufactured coke oven ---- million cubic feet	[e]33,600	[e]37,000	NA
Natural:			
Gross production:			
Associated ---- do	222,658	222,940	230,462
Nonassociated ---- do	953,527	1,053,573	1,015,468
Total ---- do	1,176,185	1,276,513	1,245,930
Marketed production ---- do	[r]1,041,857	1,136,432	[e]1,103,620
Petroleum:			
As reported ---- thousand tons	14,590	14,700	14,650
Converted ---- thousand 42-gallon barrels	108,739	109,559	109,186
Refinery products:[3]			
Gasoline ---- do	34,408	38,395	37,961
Jet fuel and kerosine ---- do	7,890	8,742	8,029
Distillate fuel oil ---- do	41,112	46,901	48,356
Residual fuel oil ---- do	39,887	50,829	50,989
Lubricants ---- do	4,200	4,676	4,242
Other:			
Liquefied petroleum gas ---- do	2,912	3,097	3,144
Asphalt ---- do	3,697	3,951	4,357
Total ---- do	134,106	156,591	157,072

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, antimony, asbestos, gypsum and natural gas liquids as well as a variety of crude construction materials are produced, but output is not reported quantitatively, and available information is not adequate for formulation of reliable estimates or output levels.

[2]Previously erroneously listed as including blast furnace ferroalloys.

[3]Romanian sources do not indicate whether refinery fuels are reported as a part of the listed product yields or not. Moreover, additional minor products may be produced, but are not listed in official sources.

TRADE

The Romanian foreign trade turnover (exports plus imports) in 1977 reached 69,773 million lei, an increase of 15% over that of 1976. Exports amounted to 34,894 million lei, which is a 14% increase over that of 1976, and imports were 34,879 million lei, which is 15% higher than in 1976. Thus, the budget of 70 billion lei was slightly short of the plan target. According to the 1978 plan, the volume of foreign trade will amount to 82 billion lei, a 17% increase. In the 1976-80 period, foreign trade turnover was planned to increase by nearly 17% per year. Romanian export and import indicators are not published separately, but overall trade goals emphasize an increase in industrial exports, particularly those paid for in convertible currencies.[8]

In 1977, Romania continued its expansion of international economic cooperation. Approximately 300 projects and 20 agreements of understanding in economic and technological cooperation were concluded, 128 new facilities and joint companies were set up abroad and 31 in Romania. Of the 57 joint production companies, 8 were headquartered in Romania and 28 abroad, and 35 new commercial companies were established.[9]

Economic relations and cooperation with CMEA[10] member countries and other centrally planned economy countries continued to be expanded and diversified in 1977. Commercial exchange and cooperation with the developing countries and with the market economy countries was also promoted and developed. In 1977, Romania had economic and commercial exchanges and cooperation with 140 countries. Approximately 19% of Romania's trade is with the Soviet Union (13,341 million lei in 1977), which is its most important supplier of iron ore, coke, and other raw materials. Romania's second largest trading partner in 1977 was

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the Federal Republic of Germany, (5,201 million lei) which held a 7.5% share of Romanian trade. The Democratic Republic of Germany took third place with 5,106 million lei, followed by Czechoslovakia with 3,614 million lei; Poland followed Czechoslovakia with 2,805 million lei. The United States was in sixth place with 2,796 million lei in 1977. Despite Romania's efforts to balance its trade with developed western countries by increasing exports of finished goods and by reducing imports, the actual trade balance was worse in 1977 than in 1976.[11] Romanian trade has been operating at a deficit (although recovering somewhat from a post-1974 slump), especially with Switzerland and Japan, but now also with the Federal Republic of Germany and the EEC[12] as a whole. Worldwide, Romanian trade showed a deficit of 14 million lei.

The U.S. share of the Romanian market in 1977 was 4%. Romania's 1978 foreign trade plans include a $650 to $750 million level with the United States.[13] Strong ties were maintained with the United States and Romania was the second CMEA member after Poland to be granted "most favored nation" trading status by the United States. One of the major agreements of 1977, for example, was negotiated by Romania with the Island Creek Coal Co. of the United States.

In the field of nuclear power, negotiations with Canada for the delivery of nuclear power stations to Romania began in 1969 and have continued since then. According to some reports, an agreement is to be signed in 1977 for work on the first nuclear plant to begin in 1978. It should also be recalled that a Romanian-Soviet agreement to build a 440-megawatt nuclear powerplant in Romania was signed in 1970, with the plant to start operating in 1978.

Romania is the only Warsaw Pact country that maintains normal state and party relations with Mainland China. The total exchange between Romania and China increased from 342 million lei in 1960 to 2.5 billion lei in 1977. An increase of 20% was planned for 1977 (4% actual) and a significant increase is anticipated in 1978. Romania is looking for new energy sources and may offer in exchange for Chinese oil its high-quality drilling equipment. China may also be capable of providing Romania with nuclear power technology, now sought by Romania on the world market.

Romania is also cooperating successfully with Greece on various projects, one of them being the exploration of Greek oil deposits, discovered in 1973 in the Mesta River Valley in Greece. Romanian transactions with Greece amounted to 775 million lei (US$115 million) in 1977, and are expected to increase in 1978. Romanian exports to Greece include chemicals and machinery, while its imports are mainly food stuffs, but also bauxite.

Exports.—In recent years, the Romanian foreign trade has undergone a change in two significant ways: (1) Romania has gradually abandoned the position of exporter of raw materials and fuel, and (2) Romania has now become an importer of raw materials and fuel for its industry. Nevertheless, some groups of goods still make up a large portion of Romania's exports, especially those that require only a low degree of processing. Thus, even though 8,844,000 tons of crude oil were imported in 1977, significant quantities of petroleum products requiring primary processing were exported during the same year. The following table shows some of the primary products that were exported by Romania in 1977.[14]

Table 2.—Romania: 1977 production and exports of some primary products

Product	Produced (thousand tons)	Exported (thousand tons)
Gasoline	4,466	1,786
Diesel fuel	6,482	2,025
Fuel oil	7,656	2,502
Mineral oils	606	339
Ferrous mill products	8,392	1,353

Romania is one of the largest producers and exporters of equipment for petroleum and gas drilling extraction and processing. The equipment-machine building and chemical industries in 1976 accounted for over half of Romania's total exports and in 1977 the former accounted for 27% of its exports. This trend is expected to continue to 1980, and by 1990 machine building alone is expected to account for 45% of its exports.

Imports.—Romania's imports in 1977, as in previous years, consisted mainly of two commodity groups: (1) Fuel and mineral raw materials, imports of which dropped from 41% in 1976 to 34% in 1977; (2) machines and equipment, imports of which grew from 32% in 1976 to 37% in 1977.

Despite the measures to conserve fuel and raw materials, Romania was forced to increase its imports of crude oil from 8,475,000 tons in 1976 to 8,844,000 tons

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in 1977, and imports of iron ore from 11,740,000 tons to 12,402,200 tons. Romanian oil was most likely supplied, as in the past, largely by Iraq, Iran, Kuwait, and Libya. In this connection, it should be noted that Romania's own oil production fell slightly in 1977 by 50,000 tons compared with 1976, and its iron ore production dropped by 13% from 2,835,000 tons to 2,467,000 tons.

The U.S.S.R. is Romania's main trading partner. Romania obtains from the U.S.S.R. hard coal, metallurgical coke, iron ore, asbestos, apatite concentrate, pig iron and ferroalloys, rolled ferrous metal products, and scrap and rolled nonferrous metal products. Complete installations of large-scale enterprises in the metallurgical, power, and chemical industries also account for a large share of Soviet deliveries. Those included the metallurgical complex in Galati, Tîrgoviste, and Iasi; chemical complexes in Borzesti; and the hydroelectric power station in the Iron Gates region. According to existing agreements, Romania will receive natural gas, a considerable quantity of pelletized iron ore, asbestos, and certain types of ferroalloys from the U.S.S.R. for a long time, at least until 1990.[15]

The average annual growth rate of Romanian trade with Bulgaria, its southern neighbor, was 21% in 1970-77. In recent years, Romanian imports from Bulgaria were made up of machinery, equipment, fuels, mineral raw materials, and metals, essentially the same items as those imported from the U.S.S.R. The average growth rate of imports of fuels, raw materials, and metals was 25%, 21% for machinery and equipments, and 20% for chemical products and fertilizers. Commodity items such as coke, steel, pipe, ores, metals, and so forth were also imported from Bulgaria. Of great significance to the Romanian-Bulgarian economies is their joint use of the electric power system. The two countries (in cooperation with the U.S.S.R.) have agreed to build a 750-kilovolt electric transmission line from the Odessa substation (U.S.S.R.) by way of the Mucin substation (Romania) to the Dobrudzha substation in Bulgaria.[16]

Table 3.—Romania: Exports of selected mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975[1]	1976[2]	Principal destinations, 1976
METALS			
Aluminum metal including alloys:			
Scrap	7,194	2,329	Italy 1,586; West Germany 699.
Unwrought	84,700	[3]75,000	Japan 25,834; Hungary 12,304; France 11,101.
Semimanufactures	11,253	[4]16,938	Hungary 5,056; Japan 4,541; Poland 1,314.
Copper metal including alloys, all forms	3,965	3,101	West Germany 3,061.
Iron and steel:			
Roasted pyrite thousand tons	11,482	4,659	All to Austria.
Scrap do	1,966	7,325	Spain 6,269; Italy 1,056.
Pig iron, ferroalloys, castings do	128,341	48,545	Italy 21,168; Sweden 20,433.
Steel, primary forms do	157,577	481,275	Poland 147,785; Spain 122,781; Italy 93,306; Yugoslavia 61,585.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	70,918	[4]65,414	West Germany 34,306; Yugoslavia 13,843; Finland 13,465.
Plates and sheets do	227,054	[4]135,995	West Germany 72,824; United Kingdom 16,256.
Hoop and strip do	10,503	176	All to Finland.
Wire do	25,537	[4]24,766	West Germany 11,046; Yugoslavia 10,546.
Pipes, tubes, fittings do	316,000	[3]376,800	U.S.S.R. 210,195; West Germany 25,472.
Unspecified do	713,629	225,129	U.S.S.R. 121,172; Poland 58,726; Hungary 45,231.
Platinum, unwrought, partly worked value, thousands	--	$26	All to France.
Silver, waste and sweepings do	$1,293	$1,535	United Kingdom $1,191; Italy $344.
Tungsten, metal	NA	7	All to West Germany.
Other:			
Nonferrous scrap, n.e.s	--	321	Italy 208; Belgium-Luxembourg 92.
NONMETALS			
Cement, hydraulic thousand tons	2,835	[3]2,713	Hungary 239; Czechoslovakia 118.
Clay products, nonrefractory	15,094	[4]5,851	Yugoslavia 5,332.

See footnotes at end of table.

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Table 3.—Romania: Exports of selected mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975[1]	1976[2]	Principal destinations, 1976
NONMETALS —Continued			
Diamond:			
Gem, not set or strung ____ value, thousands	--	$99	All to United Kingdom.
Industrial ____ do	$1,266	$483	All to Belgium-Luxembourg.
Fertilizer, manufactured:			
Nitrogenous	230,513	[4]286,787	France 128,124; West Germany 98,121.
Phosphatic	25,495	419	All to West Germany.
Potassic	--	909	All to Italy.
Mixed	5,336	15,263	West Germany 10,264; Yugoslavia 4,999.
Gypsum, calcined	27,960	28,247	All to Hungary.
Lime, calcined	14,647	9,846	Do.
Salt	678,600	[4]667,500	Hungary 281,186; Yugoslavia 105,153.
Sodium and potassium compounds:			
Caustic soda	222,700	[3]279,900	U.S.S.R. 62,972; Hungary 50,981.
Soda ash	35,500	[3]444,700	U.S.S.R. 79,792; Czechoslovakia 42,000; Hungary 35,700; West Germany 27,416.
Stone and sand and gravel:			
Dimension stone, worked	20,789	13,872	West Germany 11,573.
Other	3,273	1,844	West Germany 1,242.
Unspecified	154,135	106,875	All to Hungary.
Talc, natural, steatite	1,006	699	All to West Germany.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	--	4,579	All to Yugoslavia.
Carbon black	30,300	[3]36,700	Czechoslovakia 9,960; Hungary 1,263.
Coal	--	1,896	All to Austria.
Gas, natural and manufactured ___ million cubic feet	6,851	[4]7,074	All to Hungary.
Peat and briquets	4,565	3,639	Austria 2,487; Italy 1,152.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	675	3	All to Yugoslavia.
Refinery products:			
Gasoline ____ do	12,442	[3]13,341	Netherlands 3,945; West Germany 3,456.
Kerosine ____ do	34	[3] --	
Distillate fuel oil ____ do	15,101	[3]17,125	West Germany 2,502; France 2,322.
Residual fuel oil ____ do	15,038	[3]24,119	Sweden 4,882; Italy 4,159.
Lubricants ____ do	2,149	[3]1,924	Spain 22; Belgium-Luxembourg 13.
Other:			
Mineral jelly and wax ____ do	57	[3]62	Hungary 49; Finland 7.
Petroleum coke ____ do	533	[3]322	West Germany 141; Yugoslavia 45.
Unspecified ____ do	118	[3]67	
Total ____ do	45,472	[3]56,960	West Germany 6,961; Sweden 5,180; Italy 5,139.
Mineral tar and crude chemicals derived from coal, gas and oil distillation	55,952	45,174	West Germany 19,048; Italy 16,154.

NA Not available.
[1]Compiled from 1975 edition of Supplement to the World Trade Annual, v. 1, Walker and Co., N.Y., 1977.
[2]Compiled from 1976 edition of Supplement to the World Trade Annual, v. 1, (Eastern Europe and the U.S.S.R.), Walker and Co., N.Y., 1978, pp. 359-400; and official trade statistics of Czechoslovakia, Hungary, East Germany, Poland, and the U.S.S.R.
[3]Source: Official trade statistics of Romania.
[4]Partial figure; tonnage not available for all destinations.

Table 4.—Romania: Imports of selected mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975[1]	1976[2]	Principal sources, 1976
METALS			
Aluminum:			
Bauxite	609,565	592,523	Greece 444,949; Yugoslavia 145,574.
Alumina	84,606	36,998	Italy 12,988; Hungary 18,432.
Metal including alloys, all forms	24,798	23,994	Hungary 20,964; West Germany 1,169.

See footnotes at end of table.

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Table 4.—Romania: Imports of selected mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975[1]	1976[2]	Principal sources, 1976
METALS —Continued			
Arsenic, acid	--	86	All from France.
Chromium, ore and concentrate	--	240	All from Italy.
Cobalt, oxide and hydroxide	4	29	United Kingdom 26.
Copper:			
Ore and concentrate	847	1,245	All from Austria.
Metal including alloys, all forms	24,143	18,527	Belgium-Luxembourg 8,000; West Germany 4,351; Italy 2,964.
Iron and steel:			
Iron ore and roasted pyrite, thousand tons	10,873	[3]11,740	U.S.S.R. 5,166.
Pig iron, sponge iron, powder and shot, do	583	[3]561	U.S.S.R. 343; Australia 58.
Ferroalloys, do	175	[3]223	U.S.S.R. 101; Norway 26.
Steel, primary forms, do	15	202	France 59; Czechoslovakia 53; Yugoslavia 26; Italy 24; Belgium-Luxembourg 20.
Semimanufactures:			
Bars, rods, angles, shapes, sections, do	433	[4]207	West Germany 68; Italy 38; Hungary 30.
Plates and sheets, do	198	[4]189	West Germany 44; Hungary 27; France 24; Belgium-Luxembourg 24.
Hoop and strip, do	82	[4]108	Hungary 48; West Germany 35.
Rails and accessories, do	70	26	Yugoslavia 25.
Wire, do	12	[4]9	West Germany 6; Belgium-Luxembourg 2.
Pipe, tubes, fittings, do	82	[3]101	Hungary 44; West Germany 28; Japan 11.
Other, unspecified, do	775	1,401	U.S.S.R. 521.
Total, do	1,652	[3]2,041	U.S.S.R. 531; West Germany 206; Hungary 149.
Lead:			
Ore and concentrate	4,102	2,504	All from Italy.
Oxides	1,076	2,639	France 1,375; Austria 1,218.
Metal including alloys, all forms	4,244	2,998	All from Yugoslavia.
Manganese	493	1,070	Greece 440; Japan 400; Ireland 230.
Mercury, 76-pound flasks	2,030	6,670	Spain 4,031; Italy 2,639.
Molybdenum, metal	4	6	All from Austria.
Nickel, metal including alloys, all forms	1,137	[4]1,197	France 622; West Germany 242.
Platinum-group metals, unwrought and semimanufactures, value, thousands	$1,761	$1,552	United Kingdom $829; West Germany $438; Austria $153.
Silver, metal, unwrought and semimanufactures, do	$414	$159	France $77; Switzerland $51.
Tin, metal including alloys, all forms	187	191	Spain 185.
Titanium oxides	1,246	1,125	West Germany 905.
Tungsten, metal, all forms	14	[4]7	France 4; Austria 2; United Kingdom 1.
Zinc:			
Ore and concentrate	--	5,503	Austria 3,003; Italy 2,500.
Oxide and peroxide	2,030	1,010	All from Yugoslavia.
Powder (blue dust)	1,840	2,841	Belgium-Luxembourg 1,890; West Germany 951.
Metal including alloys, all forms	6,750	6,590	Finland 4,000; Netherlands 2,000.
Other:			
Ore and concentrate	2,434	1,481	All from Hungary.
Oxides, hydroxides and peroxides of metals, n.e.s	45	73	All from France.
Metalloids	3,015	[4]3,443	Yugoslavia 2,056; Norway 1,106.
Base metals including alloys, all forms, n.e.s	21	510	Japan 390; United Kingdom 43.
Unspecified nonferrous metals and alloys	NA	NA	All from U.S.S.R.
NONMETALS			
Abrasives:			
Natural	108	229	All from Italy.
Manufactured	3,517	4,046	Italy 1,439; Austria 1,317; West Germany 336; Yugoslavia 361.
Asbestos	41,299	7,641	Canada 3,357; West Germany 3,156.
Barite and witherite	5,704	3,885	All from West Germany.
Cement	126	--	
Chalk	1,528	--	
Clay and clay products:			
Crude	31,586	21,353	Czechoslovakia 11,000; Greece 5,102; United Kingdom 4,761.
Products:			
Refractory	66,251	[4]95,966	Yugoslavia 29,128; U.S.S.R. 23,538; West Germany 10,070; Italy 8,257.
Nonrefractory	40	NA	

See footnotes at end of table.

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Table 4.—Romania: Imports of selected mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975[1]	1976[2]	Principal sources, 1976
NONMETALS —Continued			
Diamond:			
Gem, not set or strung -- value, thousands	$1,459	$1,251	All from United Kingdom.
Industrial ---do---	$2,534	$2,610	Belgium-Luxembourg $2,547.
Diatomite and other infusorial earth	1,091	1,124	Iceland 704; France 420.
Feldspar and fluorspar	2,130	3,258	Italy 2,445; Spain 532; West Germany 281.
Fertilizer materials:			
Crude, phosphatic, apatite concentrate, gross weight	1,309,644	[4] [5]1,738,324	United States 210,679.
Manufactured:			
Phosphatic	7,303	[5]4,800	All from Israel.
Potassic	220,912	[5]263,221	U.S.S.R. 114,701; East Germany 54,100.
Graphite	117	185	All from West Germany.
Magnesite:			
Crude	2,994	10,700	All from Greece.
Products	45,439	39,000	All from Czechoslovakia.
Mica, worked	16	14	All from France.
Pigments, mineral, iron oxides	428	269	All from West Germany.
Pyrites, unroasted	123,320	196,153	All from Yugoslavia.
Stone and sand and gravel	1,880	87	Do.
Sulfur:			
Elemental, including colloidal	115,954	117,672	Poland 117,000.
Sulfuric acid	86,290	36,731	Greece 12,018; Yugoslavia 5,044; West Germany 4,306.
Talc	205	334	All from Italy.
Other crude minerals	1,623	1,415	Italy 871; West Germany 344.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	2,187	594	West Germany 575.
Coal	2,420	[5]2,623	Czechoslovakia 794; U.S.S.R. 664; United States 192; Australia 48; West Germany 26.
Coke	2,537	[5]2,816	Czechoslovakia 445; Italy 402; West Germany 189; Yugoslavia 110.
Hydrogen, helium, rare gases	248	180	All from West Germany.
Petroleum:			
Crude ------ thousand 42-gallon barrels	37,893	63,164	NA
Refinery products:			
Gasoline ---do---	NA	9	All from Greece.
Kerosine ---do---	11	24	Greece 19; Hungary 2.5.
Distillate fuel oil ---do---	1	12	All from Greece.
Lubricants ---do---	[4]12	15	Austria 4; Netherlands 4; West Germany 2.4.
Other, unspecified ---do---	144	149	West Germany 145.
Total ---do---	[4]168	[4]209	West Germany 148; Greece 37.
Tar and other coal-, petroleum-, or gas-derived crude chemicals	13,172	10,414	U.S.S.R. 9,414; West Germany 1,000.

NA Not available.

[1]Compiled from 1975 edition of Supplement to the World Trade Annual, v. 1, Walker and Co., N.Y., 1977.

[2]Compiled from 1976 edition of Supplement to the World Trade Annual, v. 1 (Eastern Europe and the U.S.S.R.), Walker and Co., N.Y., 1978, pp. 359-400; and official statistics of Czechoslovakia, Hungary, East Germany, Poland, and the U.S.S.R.

[3]Source: Official trade statistics of Romania.

[4]Partial figure; tonnage not available for all sources.

[5]Reported in Romania trade statistics in nutrient content; conversion used: 39.4% P_2O_5 and 41.6% K_2O.

COMMODITY REVIEW

METALS

Even though Romania is not rich in mineral resources, the mining and metallurgical industries are quite diversified. Iron ore mining and steel production are important aspects of Romanian ferrous industry. The production of the metallurgical industry rose by 11% in 1976 and again by 11% in 1977. The country occupies 14th place in the world in per capita production of steel. Results for 1977 in metallurgy are considered good and are officially attributed to the introduction of new technologies and better use of existing equipment. They may also reflect the more extensive use of productivity bonuses in steelmaking.

Since the basic raw material used for

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metal production (ores, coke, and coking coal) are largely imported, their rational use, as well as strict conservation of fuel and power resources, were one of the major objectives of the Romanian economy in 1977. Romania is deficient also in the nonferrous metals, most of which it receives from the U.S.S.R.

There is lack of reliable information on Romanian bismuth, gold, and silver production. However, since these metals are derived as a byproduct from ores processed for other metals, mainly lead, copper, tin, and molybdenum, quantities are most likely produced in Baia-Mare, Roşia Montana, Moldova or Bolan areas.

Aluminum.—In 1977, Romanian production of primary aluminum reached 209,000 tons, an increase of only 1% over that of 1976 and 2.5% over 1975. The single aluminum reduction plant at Slatina again surpassed its annual production capacity of 200,000 tons in 1977.

Bauxite is provided partly from domestic mines located in the Oradea area near Dobresti and partly from imports from Greece and Yugoslavia. Romanian imports of bauxite from Greece are expected to be 850,000 tons in 1978.[17] The two Romanian alumina plants of 250,000 tons per year capacity each are located near the Oradea bauxite mines and near Tulcea in the Danube delta. Expansion of these facilities to use siliceous bauxite from Ohaba-Ponor will eventually raise the aluminum metal output to 260,000 tons by 1980. The Tulcea enterprise was put into operation in 1973 and is the largest Romanian alumina plant, with an annual processing capacity of 600,000 tons of bauxite. The Tulcea enterprise continued in 1977 to upgrade its new foil-rolling mill and to experiment with the production of new aluminum alloys.

Copper.—Romania's production of refined copper in 1977 is estimated at 40,000 tons. The most important Romanian copper mines are located at Baia-Mare in the northwestern part of the country just 45 kilometers south of the Soviet-Ukranian border, including the Baia Sprie and Cavnic mines. In 1977, the low-grade copper deposits (0.3% copper) were mined at Moldova Nova and Roşia Poieni areas, which were discovered relatively recently. As reported previously, two additional mines were to be opened there, one in 1978 and another in 1979, with a combined capacity of 20 million tons of ore per year. The other copper mining area is Roşia Montana (Noua, Borsa, Balan, and Lesul Ursului mines).

One potential prospect for U.S. firms in Romania is the planned expansion of copper production. Romania's goal is to become self-sufficient in copper by 1984. Reportedly, American firms may have the advantage in both projects currently under development in Moldova Nova and Roşia Poieni. A number of firms such as Amero, Fiat-Allis, Allis Chalmers, and Pullman, have made offers of equipment sales for the project.[18]

According to the 1977 state decree, a Baia-Borsa mining enterprise was established in 1977, with headquarters in Borsa in Maramures County. This was essentially a reorganization of the Baia-Borsa mine and being subordinate to the Baia-Mare Central for nonferrous metallurgy and ores. Its main objective will be the production of nonferrous ore concentrates, geological investigations, and mine development.

Iron and Steel.—Crude steel production continued to rise and reached 11,457,000 tons in 1977. The 1977 iron ore production slipped, however, to 2,467,000 tons or 13% below the 1976 level. The three major iron ore mines, located at Hunedoara, Cluj (now renamed Napoca), and Resita, are able to produce about 3.3 million tons of ore annually. Iron ore reserves are limited and the steel industry, because of its growth, has increased its imports.

The U.S.S.R. was the major source in 1977 of Romanian imported iron ore and pig iron, as shown in the following tables:[19]

Table 5.—Romania: Imports of iron ore from the U.S.S.R.

Year	Total imports (metric tons)	Soviet deliveries of iron ore	
		Metric tons	Percentage of total Romanian imports
1975	10,878,700	6,288,000	57.8
1976	11,740,000	5,135,000	43.7
1977	12,402,200	4,599,000	37.1

Table 6.—Romania: Imports of pig iron from the U.S.S.R.

Year	Total imports (metric tons)	Soviet deliveries of pig iron	
		Metric tons	Percentage of total Romanian imports
1975	583,000	385,630	66.1
1976	560,600	343,032	61.2
1977	646,300	e369,349	57.2

eEstimate.

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India is another important supplier of iron ore to Romania. Bilateral economic cooperation, including Romanian aid in constructing industrial facilities in India and the import of iron ore, actually started a number of years ago. India is supposed to supply Romania with 22 million tons of iron ore during the 1971-80 period. The 1978 imports may be from 2.5 to 10 million tons. Since the amount of iron ore imported in the last few years from the U.S.S.R. has been declining, the new agreement with India appears to make up, at least in part, for this difference.

Iron ore imports have grown from 917,000 tons in 1960 to 12,402,200 tons in 1977; pig iron imports rose from 4,000 tons in 1960 to 646,300 tons in 1977. In 1977, Romania imported almost five times more iron ore than it mined domestically. Since the current 5-year plan stipulates that steel output must go up to 18 million tons (as against 11,457,000 tons produced in 1977 and 13,724,000 tons planned for 1979), the necessary iron ore has to be supplied largely through imports.

In 1977, two continuous-casting steel mills were installed at Galati, two at Otelul Rosu, and others are planned at Galati, Hunedoara, and Calarasi. By 1980, the continuous-casting installations are to produce 3.5 million tons of steel. In 1977, a number of 2,700-cubic-meter blast furnaces were installed as well as Martin furnaces for 400-ton charges and oxygen injection.[20] The Galati enterprise employs 22,000 workers and is the largest Romanian iron and steel plant. Its construction began in 1960, and in 1977 it produced nearly 6 million tons of steel. The Galati enterprise now has five blast furnaces, four of 1,700- and one of 2,700-cubic-meter capacity. The Galati combine accounts for almost 60% of Romania's pig iron production, 47% of steel, and 92% of cold-rolled steel sheet and strip products.

Steel production at the Resita complex is expected to reach 2 million tons per year in the future. The Otelul Rosu iron and steel works of Caransebes in Caraş-Severin County produced 512,000 tons of steel in 1977.

Romanian steel output by process is presented in the following table (in thousand metric tons):[21]

Process	1975	1976	1977
Oxygen converter	3,568	4,452	4,853
Open hearth	4,768	4,798	4,895
Electric	1,213	1,483	1,709
Total	9,549	10,733	11,457

By 1980, over 70% of the steel in Romania is planned to be produced by oxygen converters and electric furnaces. Steel production in 1978 is expected to reach 12 million tons. The Galati complex is to account for 47% of the total, the Hunedoara enterprise for 30%, and that at Resita for 13%. By 1980, Romania plans to produce over 17 million tons of crude steel per year. Long-term plans call for producing 25 million tons of steel by 1990, which may be taken to mean as substantial commitments for imported iron ore.

Lead and Zinc.—Smelter output of lead in 1977 remained at 32,000 tons, and that of zinc decreased to 55,000 tons in 1977. The only Romanian lead-zinc smelter is located at Copsa Mica in central Romania and is administered by the Uzina Chimica Metallurgica.

Almost all of Romania's lead and zinc concentrate comes from the Baia-Mare mining complex, some from Balan, and several other smaller sulfide ore mines. The Baia-Mare mill feed is a low-grade ore assaying from 0.50% to 0.54% lead, 0.07% copper, and 2.10% to 2.47% zinc.[22]

NONMETALS

Among nonmetallics, Romania has a well-developed sodium products industry that is based upon an estimated 20 billion tons of reserves. Barite is mined at an annual rate of 100,000 tons at Ortra. One of the larger nonmetallic enterprises is the Cluj (Napoca) mining complex, processing such products as kaolin, feldspar, bentonite, refractory materials, quartzite, and others.

Barite.—Barite production was estimated to be 85,000 metric tons in 1977. Barite is mined at Ortra, adjacent to the Lesul Ursului copper mine in the Roşia Montana area of northwestern Romania. Most of the barite is used domestically in the oilfields. In 1977, Romania continued to import barite from the Federal Republic of Germany at

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3,970 metric tons annually, which is a 2.2% increase from the previous year. In 1977, Romania was also negotiating import of barite from Thailand at 2,000 tons annually.

Cement.—Cement production in 1977 was 13.9 million tons, a 6% increase over that of 1976. By 1980, Romania plans to produce 20 million tons of cement annually. Romania again continued its steadily rising export of cement and in 1977 exported 3.1 million tons (up by 14.2% over 1976) mostly to Yugoslavia and Czechoslovakia.

Production in 1977 began at the Taşca cement plant in the Neamt district. The plant was started in 1975 and is the biggest and most technologically advanced in Romania, employing the dry method. A new lime and cement production line, with an annual capacity of 320,000 tons, was commissioned at the Tirgu Jiu building materials complex. Other plants that produce lime are located at Tiraveni and Bicaz. Romania has 12 cement plants.[23]

Fertilizer Materials.—Romania's total fertilizer production in 1977 was 1,929,000 tons (100% nutrient content), an increase of 6% over that of 1976. At the same time, over 2 million tons of chemical fertilizer was exported by Romania in 1977.

New Romanian complex fertilizer plants put into expanded operation in 1977 included a plant at the Turnu Magurele and new ammonia and urea plants at the Navodary, Craiova, and Arad. At the Bacau complex, a diammonium phosphate plant was readied for service in 1977. Other ammonia and phosphoric acid plants were also prepared for service.

Romania in 1977 imported 778,900 tons of apatite concentrate, an increase of 13.7% over the previous year and 128,500 tons of potassic fertilizer. Romania supplies almost 40% of the EEC requirements in fertilizers, especially nitrogenous.

The Romanian state agency, Romchim, plans to award the Belgian-based firm Coppee-Rust a contract to provide technical assistance for constructing two urea plants as the first stage of major fertilizer expansion program. This order will follow six other urea projects placed with Coppee-Rust, the first dating back to 1966. Construction of the two 420,000-ton-per-year units has already begun and the cost is estimated to be about $25 million each. They will be based on Stamicarbon process technology and will be similar to the 420,000-ton-per-year Bacau project that Coppee-Rust announced in December 1975.

Two gas-based ammonia plants, to provide the raw material for the urea facilities, are also being built in Romania based on Kellogg process engineering. Kellogg is responsible for supervision and some construction on the plants, each of which has a capacity of 300,000 tons per year. The urea produced from these two plants will be for export and is part of Romania's plan to more than double fertilizer nutrient output in the current 5-year plan.[24] By 1980, Romania expects to produce 4 million tons of fertilizers, thus doubling the 1977 volume. The plan emphasizes the manufacture of nitrogenous fertilizers, with production scheduled to amount to 3 million tons per year by the end of the 5-year plan.

Feldspar and Fluorspar.—Production in 1977 has been estimated at 60,000 tons of feldspar and 20,000 tons of fluorspar. Imports of those two minerals are mostly from Italy and some from the United Kingdom, ranging from 1,500 to 4,000 tons annually, depending on requirements. In 1977, negotiations were being conducted for imports of fluorspar from Thailand at quantities of up to 6,500 tons annually.[25]

Salt.—Salt production in Romania has been slightly but steadily increasing since 1975, and in 1977 it was 4.5 million tons, an increase of 7.7% from 1976. Romania exported 715,000 tons of salt in 1977 to Yugoslavia, Greece, and the Federal Republic of Germany, an increase of 7.1% over the previous year.

Romanian salt reserves are estimated at 20 billion tons, with major halite deposits and mines located in the Precarpathians in Transylvania.

Sulfur.—The production of sulfuric acid was 1,523,000 tons in 1977, a slight decline from that of 1976. Romanian plant capacity for the production of sulfur is estimated at 400,000 tons annually.[26] As reported previously, a plant was to be constructed to utilize the pyrite recovered as waste from the sulfuric acid plant located at the Turnu Magurele complex, where annual sulfuric acid production capacity was 300,000 tons per year, using the Lurgi process.

MINERAL FUELS

The Romania current 5-year plan provided for radical changes in the uses of energy resources, especially in the consumption conservation. Of the total of 7,155 megawatts of electric power to be installed in the 1976-80 period, the primary fuel to be used

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in the generation of this power are to be as follows: 4,225 megawatts (59.2%) from thermal power stations using coal and oil shale as fuel; 1,743 megawatts (24.4%) from hydropower; 937 megawatts (13%) from plants fired by oil; and 250 megawatts (3.4%) from plants fueled by secondary and recovered energy resources.

The total primary energy balances for Romania for 1976-77 are shown in table 7.

Table 7.—Romania: Total primary energy balance for 1976 and 1977

(Million tons of standard coal equivalent[1])

	Total primary energy	Coal (lignite, anthracite, bituminous) coke	Crude oil and petroleum products	Natural and associated gas	Hydropower
1976:[2]					
Production	86.0	15.1	21.6	48.3	1.0
Imports	17.8	5.2	12.5	--	.1
Exports	12.6	--	12.0	.3	.3
Apparent consumption	91.2	20.3	22.1	48.0	.8
1977:[2]					
Production	85.0	15.4	21.5	46.9	1.2
Imports	18.5	5.3	13.0	--	.2
Exports	10.9	--	10.3	.3	.3
Apparent consumption	92.6	20.7	24.2	46.6	1.1

[1]1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories. Conversion factors used are: Hard coal, 1.0; lignite and brown coal, 0.33; coke, 0.9; crude oil, 1.47; refinery products, 1.53; natural gas, 1.33 (per thousand cubic meters); hydroelectric power, 0.125 (per thousand kilowatt-hours).

[2]Production and trade data were taken from the Statistical Yearbook of the Socialist Republic of Romania (Bucharest), 1978.

Source: World Energy Supplies, Statistical Papers, Series J, No. 18, (United Nations) New York, 1975.

Coal.—In 1977, Romania produced 29.1 million tons of run-of-mine coal and lignite, a 4% increase over its 1976 production. The total marketable (net) coal and lignite production in 1977 was 26.8 million tons.

Romania imported coal from various countries including CMEA partners, Australia, and in 1977 from the United States. In 1977, Romania contracted to purchase 27.3 million tons of coal from the Island Creek Coal Co. in Virginia. Negotiations were also underway in 1977 between Romania and Kaiser Resources Ltd. (Vancouver, Canada), for delivery of Canadian metallurgical coal to Romania between 1978-80.[27]

Lignite makes up 70% to 80% of Romanian domestic coal production and forms the most important coal reserves (90%), located mainly in the Oltenia region (Jiu Valley), in a large basin on the southern flank of the Carpathian Mountains. Other easily mined (open cast) lignite deposits are found in the Crisana area, which would be capable of satisfying a considerable part of the energy needs. Smaller coal deposits are located in the Brasov, Arges, and Ploesti areas but are only of local importance. Geologists estimate the reserves of the Oltenia basin at more than 3 billion tons, of which about 1 billion tons are of commercial quality. The coal seams in the basin are from 1 to 12 meters thick and open cast mining is easy. The Rovinari mine is one of the main coal mines, which supplies about half of Romania's lignite output. The two other most important mines in the Oltenia region are the Motru and Jilt. The Jilt open cast mining area is considered to be potentially the country's second most important after the Jiu Valley and its biggest lignite producer. At present, the Oltenia region is already the main supplier of fuel for the large Turceni thermoelectric stations built in the area. Oltenia will become one of the most important mining regions of the country, with new names added to the already operating mines. The Cicani, Beterega, Girla, Tismana, Horesti, and Leurda are already in operation and others still in the planning stage are the Plostina, Lupoaia, and Rosiuta in the Motru area.

Anthracite and bituminous coal are mined mostly from the Jiu Valley coalfield, which is being steadily expanded.

The current 5-year plan envisages mining of 56 million tons in 1980, of which 82% are to be lignite. The increase in lignite production up to 1985 will be assured by the mines already operational (72% open cast) or still being developed, and during the period 1985-90 new production capacity (75 million tons) is to be largely accounted for by

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underground mines.

Natural Gas.—Romania's natural gas production in 1977 was 35.3 billion cubic meters, which represents a decrease of 3% from that of 1976. The production of nonassociated gas was 28.8 billion cubic meters of that total in 1977.

Geologic conditions and geographic distribution of natural gas locations in Romania are very similar to those of oil. The main gas producing areas are within the Precarpathian Depression, in the vicinity of Tîrgu Mureş (Transylvania Plateau), and the Ploiesti-Craiova area (Walachia) and in the south. Romania's natural gas reserves were reestimated in 1977 at 620 billion cubic meters (280 billion in 1975) and specifically are centered around Tîrgu Mureş, Turda, Copsa Mica, and Fagares areas. At the 1975 level of demand, the supply of natural gas in Romania may last only for another 15 to 20 years.[28]

While Romania does not import oil from the U.S.S.R., trade with the U.S.S.R. is expanding. Romania plans to import approximately 1.5 billion cubic meters of natural gas from the U.S.S.R., following the completion of the Orenburg (Soyuz) pipeline sometime in 1978. Of the two other gas pipelines crossing Romania, one exports Romanian gas to Hungary and the other carries gas from the U.S.S.R. to Hungary, Romania has no rights to any of it without the U.S.S.R.'s permission.

Oil Shale.—Special attention in Romania is being paid to the exploitation of oil shale reserves to provide feedstock mostly for thermal electric power stations. Production of oil shale, with a calorific value of approximately 1,000 kilocalories per kilogram, is being planned for 1978. The output is to be on the order of 5 million tons in 1980 and 12 million tons by 1990. In 1975, Romania began the construction of its first and largest electric powerplant designed to use oil shale as fuel. The plant is located at Oravita in western Romania near the Yugoslav border. It will have a capacity of 990 megawatts and use more than 12 million tons of surface mined oil shale per year. Another thermal plant using oil shale is being planned for construction at Anina near Resita.

Romania's known deposits of oil shale are estimated at hundreds of millions of tons and future plans envisage production of over 20 million tons annually. Deposits of oil shale have recently been discovered in the Transylvanian Alps, the Apuseni Mountains, the eastern Carpathians, and the Crisul Negru Valley south of Oradea.

Petroleum.—In 1977, Romania produced 14.7 million tons of petroleum, slightly below that of the previous year. Domestic reserves of oil and natural gas are rapidly diminishing, with the output of oil and gas now declining. In 1968, Romania for the first time became a net importer of crude oil and by 1977 it imported over 8.8 million tons. The oil was supplied by Iraq, Iran, Kuwait, and Libya. Exports of petroleum products fell 14% from 7,842,200 tons in 1976 to 6,741,900 tons in 1977. Crude oil is imported not so much for domestic consumption needs as for export of processed products, such as gasoline, diesel oil, oil residues, mineral oil, asphalt, paraffin, petroleum coke, and other primary products.

Romania imports no oil from the U.S.S.R., although it is scheduled to import gas in 1978 through the Orenburg pipeline. Iran in 1977, supplied Romania with 5 million tons of oil, or 57% of total 1977 oil imports. Romanian imports from Kuwait amounted to 454 million lei, of which crude oil accounted for the largest part. Negotiations were also drafted for the construction of a $1,250 million joint Romanian-Kuwaiti petrochemical complex at Navodari. In the last few years, Romanian imports from Libya (including oil) dropped from 708 million lei in 1976 to 453 million lei in 1977. Discussions on oil cooperation between Romania and Libya started as far back as 1972, at which time unconfirmed sources reported Romanian purchases of 1.5 million tons of oil annually from Libya. No information is available on oil imports from Venezuela, even though it was discussed as far back as 1973.

In 1977, Romania began drilling in the Black Sea, using the domestically built jackup offshore drilling platform Gloria I. But commercial production from any offshore deposits that may be found will have little or no impact on the nation's oil supply before the 1980's.[29] Large-scale onshore exploration, superdeep drilling, in-fill drilling at fields, and greatly expanded use of enhanced recovery techniques (water, gas, and steam injection) have so far not provided significant production gains. The water and gas injection methods are now used in all Romanian fields. The in situ underground combustion oil recovery technique is used in Romania in Suplacu de Barcau, contributing up to 55% of the daily output.[30]

Crude oil production for 1978 is set at 15.1 million tons and 14.8 million tons for 1979, the only commodity whose target has been

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lowered. Constrained by falling reserves, Romania has limited its crude production gains to about 1% per year since 1972 and instead has sharply increased imports.[31] Romanian proved crude oil reserves were estimated in 1977 at about 290 million tons. Despite efforts to increase proven reserves and to explore offshore deposits in the Black Sea, it may well be that Romania will have a sufficiency of oil for only the next 20 to 30 years.

All Romanian refineries are Government-owned and are located at Brazi, Pitesti, Sulpacu, Barcau, Borzesti, Brazov, Cimina, Darmanesti, G. Ghorghiu Dej-Onesti, Ploieşti, and Teleajen. In 1977, Romanian Romchim signed an agreement with Houdry, a western firm, to build a 180- to 200,000-ton-per-year, high-purity benzene plant. Furthermore, Romania and Kuwait have agreed in principle to a joint oil refinery, aromatics separation unit, and a cracker to be built at Navodari on the Black Sea.[32] The Ploieşti project seems to be more imminent than that planned as a joint venture for Navodari.

As part of Romania's implementation of its research and design technologies, a new industrial R & D enterprise (Metal Central) for the production of oil extraction equipment will be inaugurated on January 1, 1978. Romania is well known for the manufacture of oil and mining equipment and machinery, and it capitalizes on the export of this technology. According to its own claims, Romania is the second largest exporter of oil equipment and installations in the world (after the United States).

Nuclear Power.—Due to the diminishing oil and gas reserves, Romania is in the process of expanding construction of its nuclear powerplants, importing nuclear fuel most likely from the U.S.S.R. The construction of nuclear powerplants has been postponed, however, several times. Two plants of 500- to 600-megawatt-capacity each were to be commissioned under the 1966-75 electrification plan, while the 1971-80 electrification plan called for the construction of nuclear plants totaling 1,800- to 2,400-megawatt capacity by 1980. The first units of 600 megawatts each, however, may not be commissioned until 1981-82. In 1970, Romania signed a contract with the U.S.S.R. for the joint construction of a 440-megawatt nuclear plant by 1978, but Romania has also been negotiating with a number of western countries, primarily Canada. Negotiations with Canada for the delivery of nuclear power stations began in 1969 and are continuing since then, and an agreement was to be signed in 1977 for work on the first nuclear plant to start in 1978. The most likely locations for the planned nuclear plants will be in Olt and Cernavoda. Romanian experts predict that 20% of the electric power generated in the country in 1990 will be derived from nuclear powerplants.[33] However, due to delays in construction and financing, and because no contracts for delivery of any nuclear plants have as yet been concluded, it seems unlikely that the 1990 target will be reached.

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[1]Physical scientist, Branch of Foreign Data.

[2]Values have not been converted from Romanian currency units (lei) to U.S. dollars because of the wide variation between the official exchange rate (lei6.7 = US$1.00), tourist rate (lei18 = US$1.00) and various other exchange rates used for individual transactions.

[3]Scinteia, Bucharest. Nov. 4, 1978, p. 6; Feb. 5, 1978, pp. 1-2.

[4]Anuarul Statistic al Republicii Socialiste Romania, 1978 (Annual Statistics of the Socialist Republic of Romania, 1978). Bucharest, 1978.

[5]Scinteia, Bucharest. Sept. 12, 1978, p. 3.

[6]Mining Annual Review, London. 1978, p. 589.

[7]Scinteia, Bucharest. Feb. 5, 1978, pp. 1-2.

[8]International Monetary Fund (IMF) Surveys, Washington, D.C. June 19, 1978, pp. 187-188.

[9]Revista Economica, Bucharest. No. 33, Aug. 18, 1978, pp. 13-14, 17.

[10]CMEA (also referred to as COMECON) - Council for Mutual Economic Assistance was founded in January 1949. The founder members were Bulgaria, Czechoslovakia, Hungary, Poland, Romania, and the U.S.S.R. Albania joined in February 1949 but ceased to take part in meetings in 1961. The Democratic Republic of Germany was admitted in 1950, Mongolia in 1962, and Cuba in 1972. Yugoslavia obtained permanent observer status in 1965.

[11]Revista Economica, Bucharest. No. 46, Nov. 18, 1977, pp. 13-14, 20; No. 47, Nov. 25, 1977, pp. 14, 19.

[12]EEC - European Economic Community included nine member countries in 1977; Belgium, the United Kingdom, Denmark, France, Italy, Ireland, Luxemburg, the Netherlands, and the Federal Republic of Germany; Greece will be joining the Community in 1978.

[13]The Journal of Commerce, New York. Apr. 12, 1978, p. 10.

[14]Modified after Revista Economica, Bucharest, No. 42, Oct. 20, 1978, pp. 17-18.

[15]Planovo Stopanstvo, Prague. No. 7, 1978, pp. 64-71.

[16]Work cited in footnote 15.

[17]Mining Journal, London. Jan. 13, 1978, p. 28.

[18]Eastwest Markets, London. Nov. 28, 1977, p. 2.

[19]Foreign Trade of the U.S.S.R., 1977, Moscow. 1977, p. 163; work cited in footnote 4.

[20]Revista Economica, Bucharest. No. 31, Aug. 5, 1977, pp. 9-10.

[21]Modified after Metal Bulletin, London. Sept. 5, 1978, p. 35.

[22]World Mining, San Francisco. V. 30, No. 12, November 1977, p. 58.

[23]World Cement Directory, Paris. CEMBUREAU, the European Cement Association, 1977, p. 239.

[24]European Chemical News, London. Oct. 27, 1978, p. 36.

[25]Industrial Minerals, London. August 1978, p. 56.

[26]Page 45 of work cited in footnote 25.

[27]Mining Journal, London. Mar. 17, 1978, p. 196; Eastwest Markets, London, April 1978.

[28]The Economist, London. May 6, 1978, pp. 88-89.

[29]Romanian Foreign Trade, Bucharest. No. 2, February 1977, p. 2.

[30]Revista Economica, Bucharest. No. 41, Oct. 14, 1977, pp. 5-6.

[31]The Oil and Gas Journal, Tulsa. Feb. 6, 1978, p. 46.

[32]Chemical and Engineering News, Washington, D.C. July 4, 1977, p. 7.

[33]Revista Economica, Bucharest. No. 8, Feb. 24, 1978, pp. 22-23.

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The Mineral Industry of Saudi Arabia

By Candice Stevens[1]

The petroleum industry contributed approximately 75% to Saudi Arabia's gross domestic product (GDP), estimated at $58 billion[2] in 1977. Increased oil revenues accounted for the 18% increase over the 1976 GDP of $49 billion. More than 90% of Government revenues was derived from oil company royalties and taxes. The fiscal year 1978 budget of $31.5 billion focused on a number of long-term energy projects. Included in Government objectives were increased participation in international petroleum marketing; a master gas system for the gathering, treatment, and transmission of associated gas; construction of parallel transpeninsular oil and gas pipelines linking the eastern and western coasts; and development of the energy transportation industry, including tankers.

Saudi Arabia's second 5-year development plan (1975-79) scheduled a total expenditure of $142 billion, a major share of which was to be devoted to building up heavy industry on both coasts. Under the supervision of the Royal Commission for Jubail and Yanbu, two complete industrial cities based on hydrocarbon-processing industries were to be constructed at Jubail and Yanbu. Bechtel Saudi Arabian Co. was contracted as technical consultant for the development of Jubail, located on the eastern coast north of Dhahran. Projects included an iron and steel complex, an aluminum smelter, several petrochemical facilities, two export refineries, and a fertilizer plant. Parsons-Barsil, a subsidiary of Ralph M. Parsons Co. (United States), developed the master plan for the Yanbu complex, located on the Red Sea coast north of Jidda. Projects included a petrochemical complex, a natural gas liquids (NGL) plant, and a major petroleum refinery and terminal.

Under the second 5-year plan, the mining and quarrying sector was expected to grow about 15% to contribute approximately 10% of the 1980 GDP. Several geological mapping projects and feasibility studies were underway in 1977. Mineral resources under examination included copper deposits at Kutam, gold deposits at Mahd adh Dhahab, iron ore deposits at Wadi Sawawin, and phosphate resources at Thaniyat. Saudi Arabia in conjunction with Sudan was also initiating studies of mineral recovery from Red Sea sediments.

PRODUCTION

Arabian American Oil Co. (Aramco), which produced all Saudi oil except the output shared by Saudi Arabia and Kuwait in the Kuwait-Saudi Arabia Partitioned Zone, increased production 8% from 8.3 million barrels per day in 1976 (revised) to 9 million barrels per day in 1977. Saudi Arabia continued as the second largest oil producer in the world following the U.S.S.R. In the Partitioned Zone, Arabian Oil Co., Ltd. of Japan (AOC) and Getty Oil Co. (GOC) had a combined petroleum production of 158,000 barrels per day in 1977. Aramco's crude oil reserves were estimated at 110 billion barrels; oil reserves in the Partitioned Zone totaled 3.5 billion barrels.

Saudi Arabia produced approximately 685,000 barrels per day of refined petroleum products in 1977, 70% of which came from the Ras Tanura refinery owned by Aramco.

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In addition were 33,000 barrels per day from the Partitioned Zone. NGL production increased 5.4% to approximately 70 million barrels in 1977. Other mineral products included steel semimanufactures, cement, and small quantities of nonmetals. Saudi Arabia's mineral production in 1977 is given in table 1.

Table 1.—Saudi Arabia: Production of mineral commodities

Commodity and unit of measure	1975	1976	1977[p]
NONMETALS			
Cement, hydraulic[1] thousand metric tons	[r]1,125	1,104	1,000
Gypsum do	17	17	20
Lime[e] do	15	15	20
Sulfur[e] do	3	3	3
MINERAL FUELS AND RELATED MATERIALS			
Gas, natural:[2]			
Gross million cubic feet	[r]1,354,311	1,667,904	1,719,816
Marketed[e] do	[r]122,1533	[r]138,327	158,915
Natural gas liquids:			
Propane and butane thousand 42-gallon barrels	[r]39,556	46,748	NA
Natural gasoline and other do	[r]11,305	19,665	NA
Total do	[r]50,861	66,413	70,000
Petroleum:			
Crude[2] do	[r]2,582,550	3,139,722	3,358,036
Refinery products:[3]			
Gasoline do	8,420	9,545	12,334
Kerosine do	8,832	8,333	8,443
Jet fuel do	3,589	4,338	1,982
Distillate fuel oil do	24,838	26,655	32,045
Residual fuel oil do	78,723	97,200	87,957
Other:			
Liquefied petroleum gas do	1,839	NA	NA
Naphtha do	22,031	NA	NA
Asphalt do	2,469	NA	NA
Unspecified do	--	102,039	109,976
Refinery fuel and losses do	7,055	9,292	9,374
Total do	157,796	257,402	262,111

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.
[1]Data presented are for Hejra calendar years, which correspond closely to Gregorian calendar years.
[2]Includes Saudi Arabia's one-half share of production in the Kuwait-Saudi Arabia Partitioned Zone.
[3]Includes Saudi Arabia's one-half share of production by its concessionaires in the Kuwait-Saudi Arabia Partitioned Zone.

TRADE

Saudi petroleum exports increased from 8 million barrels per day in 1976 to 8.7 million barrels per day in 1977. The main recipients of Saudi crude oil were Western Europe, Japan, and the United States. In 1977, Saudi Arabia supplied 15% of U.S. oil imports. Other major exports were 560,000 barrels per day of refined petroleum products and 216,000 barrels per day of NGL. Saudi Arabia continued as the world's largest exporter of NGL. Revenues from hydrocarbon exports were estimated at $40 billion in 1977.

Saudi Arabia's overall balance-of-trade surplus increased from $17.5 billion in 1976 to $18 billion in 1977 despite increased imports of goods and services. Almost 65% of Saudi Arabia's imports were basic construction materials, including cement (3 million tons) and steel (1.5 million tons). Important suppliers to Saudi Arabia were the United States (25%), Japan (18%), and the Federal Republic of Germany (11%).

The Saudi Government was to spend a total of $6.6 billion over the period 1978-82 to expand and develop the ports of Jidda, Dammam, Yanbu, and Jubail. Jidda and Dammam, which handled over 90% of total imports, were unable to cope with the upsurge in imports, which more than tripled in value since 1973. The expansion program included construction of new berths designed to raise the handling capacity of the four ports to 37 million tons annually, introduction of modern handling techniques, and development of administrative services and

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facilities.

Aramco's Ras Tanura terminal, rated as the world's largest offshore facility with an export capacity of 8 million barrels of crude oil per day, underwent modernization of facilities during 1977. Construction began on an NGL terminal at Ju'aymah, which was to have an export capacity of 90,000 barrels per day of propane and 40,000 barrels per day of butane.

Saudi Arabia's crude oil exports occupied approximately one-third of total world tanker capacity. Several tanker companies were formed in Saudi Arabia to take advantage of the law giving preferential right for transport of Saudi oil to Saudi companies. Most tanker companies were joint ventures of Saudi private interests and major oil and transport companies: Saudi Maritime Co. (SAMARCO) included Mobil Oil Corp., Saudinaft Tanker Co. (STC) included Shell Oil Co, Saudi International Petroleum Carrier Co. (SIPCA) included Texaco Inc., and Saudi Arabian Shipping Co. (SASCO) included Mitsui O.S.K. Lines Ltd.

Table 2.—Saudi Arabia: Exports of crude petroleum and refinery products[1]

(Thousand 42-gallon barrels)

Commodity	1975	1976	1977
Crude petroleum	2,314,945	2,868,234	3,194,904
Refinery products:[2]			
Shipments other than bunkers:			
Gasoline	[3]32,551	[3]46,438	3,241
Kerosine	3,451	1,490	6,882
Jet fuel	3,141	3,653	--
Distillate fuel oil	11,086	4,805	9,761
Residual fuel oil	26,410	12,720	14,913
Other	40,061	45,213	[3]101,690
Total	116,700	114,319	136,487
Bunkers:			
Jet fuel	--	3,353	--
Distillate fuel oil	1,262	1,457	994
Residual fuel oil	46,137	53,915	46,354
Total	47,399	58,725	47,348

[1]Includes Saudi Arabia's one-half share of exports from the Kuwait-Saudi Arabia Partitioned Zone.
[2]Excludes exports (if any) by General Petroleum and Mineral Organization (Petromin).
[3]Includes naphtha.

COMMODITY REVIEW

METALS

The Directorate General of Mineral Resources (DGMR) continued to concentrate on basic geologic mapping and exploration for metallic minerals. In 1977, several foreign companies were involved in surveys, mapping, and exploration, primarily on the Precambrian Arabian Shield. Three types of permits were granted by the DGMR: Reconnaissance permits, which allowed the holder to import equipment duty-free; exploration licenses, which entitled the holder to have exclusive prospecting rights for up to 5 years over an area of up to 10,000 square kilometers; and mining leases, which were granted as joint ventures with the Government and included an initial tax holiday of 5 years on any producing venture.

The Bureau de Recherches Géologiques et Minières (BRGM) of France was granted its sixth 2-year contract for general mineral exploration in June. Having previously concentrated on the Hejaz area north of Jidda, the BRGM was to expand its survey to central Saudi Arabia. The U.S. Geological Survey continued its investigation of the mineral deposits of western Saudi Arabia. Hunting Surveys and Consultants Ltd. (United Kingdom) was contracted in October for a land survey and mapping of 330,000 square kilometers in Eastern Province. Rio Tinto Finance & Exploration Ltd. (Riofinex), a subsidiary of Rio Tinto-Zinc Corp. Ltd. (United Kingdom), was con-

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Table 3.—Saudi Arabia: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum:		
Oxide and hydroxide	1	11
Metal including alloys, all forms	r6,604	10,898
Arsenic trioxide, pentoxide, acid	61	28
Copper metal including alloys, all forms	2,410	1,097
Iron and steel metal:		
Scrap	433	277
Pig iron, ferroalloys, similar materials	3,628	8,363
Steel, primary forms[1]	11,599	11,036
Semimanufactures:		
Bars, rods, angles, shapes, sections	199,718	597,858
Plates and sheets	47,799	93,957
Hoop and strip	2,017	5,348
Rails and accessories	757	r6,635
Wire	3,798	10,518
Tubes, pipes, fittings[2]	78,085	r143,911
Castings and forgings	r11,107	r27,314
Lead:		
Oxide	143	59
Metal including alloys, all forms	885	1,999
Magnesium metal including alloys, all forms	1	78
Manganese oxide	8	2
Molybdenum metal including alloys, all forms	50	4
Nickel metal including alloys, all forms	119	r380
Platinum-group and silver metals:		
Platinum-group troy ounces	r847,814	765,443
Silver do	r788,239	r1,667,239
Tin metal including alloys, all forms	158	r303
Titanium oxide	609	225
Tungsten metal including alloys, all forms	23	207
Zinc:		
Oxide	124	r238
Metal including alloys, all forms	1,451	3,631
Other:		
Ores and concentrates	200	r327
Oxides, hydroxides, peroxides of metals	r83	r165
Metals including alloys, all forms:		
Alkali, alkaline-earth, rare-earth metals	r236	1,267
Pyrophoric alloys	45	29
NONMETALS		
Abrasives:		
Pumice, emery, natural corundum	102	304
Grinding and polishing wheels and stones	376	650
Asbestos	10,405	11,222
Barite and witherite	2,603	30,385
Boron materials:		
Crude natural borates	16	--
Oxide and acid	6	r445
Cement	645,792	1,870,889
Chalk	766	2,355
Clays and clay products:		
Crude	5,725	14,353
Products, refractory and nonrefractory	29,156	65,246
Diatomite and other infusorial earth	22,418	3,773
Fertilizer materials:		
Crude:		
Nitrogenous	3,181	r2,607
Phosphatic	97	859
Potassic	--	517
Other	446	275
Manufactured:		
Phosphatic	712	r1,065
Potassic	23	1,245
Mixed	5,013	439
Ammonia	173	290
Graphite	17	90
Gypsum and plaster	85	995
Lime	16,380	47,331
Magnesite	4	13
Mica:		
Crude	1,039	189
Worked, including agglomerated splittings	15	17
Pigments, mineral, including processed iron oxides	1,783	1,126
Pyrite, gross weight	686	105
Salt and brine	1,784	4,266
Sodium and potassium compounds	3,387	3,314

See footnotes at end of table.

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Table 3.—Saudi Arabia: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS —Continued			
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous		6,229	7,582
Slate		50	(3)
Other		640	1,405
Worked:			
Slate		840	4,535
Paving stone and flagstone		4,423	33,492
Other		5,871	r7,515
Dolomite		463	46
Gravel and crushed rock		8,492	23,100
Sand, excluding metal bearing		1,828	833
Other		292	595
Sulfur:			
Elemental, all forms		381	20
Sulfur dioxide		10	37
Sulfuric acid		r103	66
Other:			
Slag, dross, and similar waste, not metal bearing:			
From iron and steel manufacture		1	3
Slag and ash, n.e.s		8	300
Oxides and hydroxides of magnesium, strontium, barium		1,739	154
Building materials of asphalt, asbestos, and fiber cement, including unfired clay brick		17,796	35,127
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		1,164	929
Carbon black and gas carbon		24	r31
Coal and coke, including briquets		r735	1,273
Hydrogen, helium, rare gases		181	15
Peat		24	4
Petroleum:4			
Crude and partly refined	thousand 42-gallon barrels	r10	r17
Refinery products:			
Gasoline	do	(3)	1
Kerosine and jet fuel	do	1	2
Distillate fuel oil	do	14	6
Residual fuel oil	do	3	18
Lubricants	do	243	r462
Other	do	r53	r67
Total	do	r314	r556
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		1,430	1,156

rRevised.
1May include some unspecified semimanufactures.
2Includes blanks for pipes and tubes.
3Less than 1/2 unit.
4Data exclude petroleum imports into the Kuwait-Saudi Arabia Partitioned Zone, which are included in the import table of the Kuwait chapter.

tracted to provide an overall commercial survey of the feasibility of exploiting known mineral occurrences in Saudi Arabia.

The Saudi-Sudanese Commission for the Exploitation of Red Sea Resources planned to spend $17 million in 1978 on experimental dredging of Red Sea brines. The metal-bearing sediments on the Red Sea floor were estimated to contain 5.8% zinc, 0.9% copper, and 3.5 troy ounces of silver per ton. Sampling indicated approximately 50 million tons of metalliferous bottom sediments. Preussag AG (Federal Republic of Germany was to conduct overall feasibility studies on seabed mineral exploitation. The BRGM was to act as technical consultant to the project.

Copper.—Noranda Mines Ltd. (Canada) continued its feasibility study on exploitation of the Kutam copper deposits in the south near the Yemeni border. Exploratory work has shown mineralization for 450 meters along the strike zone and 250 meters in depth. Drilling indicated one mineralized zone 66 meters wide containing between 2.04% and 4.12% copper.

Arabian Shield Development Co. proceeded with its diamond drilling program at the Al Masani copper-zinc deposits to the north of Kutam. Exploration began at this location in 1971, with drilling commencing in 1974. The mineralized zone was traced to

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the south for about 5 kilometers with an average thickness of 30 meters. Samples from the Al Masani deposit assayed 0.01 to 0.22 troy ounce gold and 0.55 to 1.29 troy ounces of silver per ton, 1.79% to 2.13% copper, and 4.00% to 8.59% zinc.

No decision was reached regarding the exploitation of copper deposits at Jabal Sayid, located between Mecca and Medina. Feasibility studies were completed by Soc. d'Études de Recherches et d'Explorations Minières (SEREM) and United States Steel Corp. Reserves were estimated at 8 million tons averaging 2.2% copper, 1.4% zinc, and 1.29 troy ounces of silver, and 0.02 troy ounce of gold per ton.

Gold.—Gold Fields Mahd adh Dhahab Ltd. (GFMAD), a Consolidated Gold Fields Ltd. subsidiary, was to complete the second stage of its exploration program at Mahd adh Dhahab in mid-1978. The Mahd adh Dhahab gold mines, located 300 kilometers northeast of Jidda, were worked at two periods during ancient times, and during modern times from 1939 to 1954 by Saudi Arabian Mining Syndicate Ltd. Preliminary estimates of remaining reserves indicated 6 million tons of ore containing 0.2 troy ounce of gold and 0.8 troy ounce of silver per ton.

Iron and Steel.—British Steel Corp. initiated its 4-year study of the Wadi Sawawin iron ore deposits located in northwestern Saudi Arabia near the Gulf of Aqaba. Its $15 million contract was for an economic feasibility study on exploitation of the deposits. Reserves at Wadi Sawawin were estimated at 350 million tons averaging 42% iron. Two other iron ore deposits have been identified in Saudi Arabia. Reserves at Wadi Fatimah, located south of Jidda, were estimated at 50 million tons averaging 45% iron. Reserves at Jebel Idsas in central Saudi Arabia were estimated at 6 million tons averaging 69% iron.

A major iron and steel complex was planned for the industrial city at Jubail. A feasibility study for the plant, to begin production in 1982, was being prepared by Korf Stahl AG (Federal Republic of Germany). Approximately 800,000 tons per year of sponge iron was to be produced by the Midrex direct-reduction process using natural gas. Saudi Arabian Basic Industries Corp. (SABIC) was to hold a majority interest in the venture.

Nickel.—The Wadi Qatan nickel deposit in southwestern Saudi Arabia was under investigation by Arabian Shield Development. Preliminary results of diamond drilling indicated an average value of 1.5% nickel on a small outcrop. In 1977, Arabian Shield Development applied for an exploration license to prospect on 1,000 square kilometers of land surrounding the Wadi Qatan nickel deposits and the Al Masani copper-zinc deposit.

NONMETALS

Cement.—Saudi Arabia's cement production capacity was rated at 1.5 million tons per year. In 1977, Saudi Arabia consumed about 5 million tons of cement, 73% of which was imported. To meet a projected annual cement demand of 10 million tons by 1980, Saudi Arabia planned extensions to existing facilities and construction of five new plants. Current capacity was concentrated in three plants, as follows:

Operator	Location	Capacity (thousand metric tons per year)
Arabian Cement Co. Ltd	Jidda	700
Yamama Saudi Cement Co. Ltd	Riyadh	400
Saudi Cement Co	Hofuf	400

Klöckner-Humboldt Deutz AG (Federal Republic of Germany) was contracted by Yanbu Cement Co. for a 1-million-ton-per-year plant at Yanbu and by Quassim Cement Co. for a 730,000-ton-per-year plant at Quassim-Buredah. Two Japanese firms, Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI) and Nichimen Co., Ltd. were to construct a 2-million-ton-per-year plant at Abqaiq for Saudi-Bahraini Cement Co. Saudi-Kuwaiti Cement Co., owned 55% by Saudi Arabia and 45% by Kuwait, was to undertake construction of a 2-million-ton-per-year plant in the Partitioned Zone. Jidda Cement Co. planned to begin construction on a 1-million-ton-per-year plant at Rabigh in 1978.

Fertilizer Materials and Sulfur.—Owing to improved maintenance and plant modifications, the Saudi Arabian Fertilizer Co.

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(SAFCO) plant had a record high production in 1977 of 152,000 tons of ammonia, 220,000 tons of urea, and 9,700 tons of sulfuric acid. The Petromin Sulfuric Acid Plant was acquired by SAFCO in January. In September, SAFCO settled its dispute with Occidental Petroleum Corp. regarding compensation for the takeover of the SAFCO facilities. Almost all production of the SAFCO fertilizer complex, located in Dammam, was exported to India and Pakistan. Production of sulfuric acid was to be increased to 200 tons per day to meet rising demand from domestic chemical industries and desalination units.

Saudi Chemical Processing Co., a joint venture of Lebanon Chemicals Inc. and Saudi Research and Development Corp. Ltd. (REDEC), was to construct a 700,000-ton-per-year triple superphosphate plant to begin production in 1981. The plant, to be located near the Gulf of Aqaba, would initially process phosphate from Jordan and later from the Thaniyat deposits in Saudi Arabia.

Phosphate.—The Swedish firm Gränges AB continued its feasibility studies of phosphate deposits in the northwestern corner of the country. Reserves were estimated at 242 million tons of phosphate grading 24% P_2O_5. Beneficiation studies conducted during the year indicated that the phosphate could be upgraded to 68% P_2O_5. For exploitation, a joint mining company was to be formed between the Saudi Government and Gränges on a 50-50 basis. Gränges planned to extend its drilling program to West Thaniyat near the Jordanian border in 1978.

Gypsum.—Saudi Arabia produced approximately 20,000 tons of gypsum in 1977 for use by local construction industries. Gypsum was quarried on the Red Sea coastal plain at Al Kabrit and Al Magnah.

Salt.—Salt was produced by solar evaporation in several localities along the Red Sea coast. Surveys indicated large amounts of bedded rock salt in the south and salt in evaporites underlying the coastal plain near Jidda. No plans were made to exploit the Jizan salt domes, south of Jidda, which were estimated to contain 33 million tons of 96% pure sodium chloride.

MINERAL FUELS

Natural Gas.—Saudi Arabia's natural gas reserves were estimated at 85 trillion cubic feet, consisting almost exclusively of associated gas. Natural gas production was estimated at 4.7 billion cubic feet per day, 80% of which was flared. The remainder was used for oilfield reinjection, fuel for local industries, or NGL producton. In 1977, facilities at Abqaiq and Ras Tanura produced 26,000 barrels per day of propane, butane, and natural gasoline for export. Aramco, which operated Saudi Arabia's gas-gathering system, continued exploration for natural gas in Rub' al Khali.

Aramco's gas-treatment system was expanded with the commissioning of the Berri NGL center in November 1977. Associated gas from the Ghawar, Ain Dar, Abqaiq, Qatif, and Berri Fields was gathered into collection centers at Abqaiq and Berri, where it was separated into NGL. The NGL output was then piped to the fractionation and treatment plant at Ras Tanura. At yearend, Aramco facilities had a production capacity of 320,000 barrels of NGL per day, approximately 75% of which was to be exported.

The processing capacity of the major gas-gathering system under construction by Aramco for the Government was reduced from 6 billion cubic feet to 4 billion cubic feet per day of associated gas. Gas was to be processed at centers located in Shedgum, Uthmaniyah, and Ju'aymah and then transported over 4,000 kilometers of pipeline to storage units, fractionating plants, refineries, and export terminals. The $14 billion system was to produce 500,000 barrels per day of NGL for export, 300 barrels per day of ethane to be used as feedstock for petrochemical industries, 1.4 million barrels per day of methane for use as fuel and feedstock, and 4,000 tons per day of sulfur. In 1977, work proceeded on the NGL centers at Shedgum and Uthmaniyah. The entire system was scheduled to be in operation by 1984.

Petrochemicals.—Saudi Arabia, through SABIC, entered into joint ventures for construction of six petrochemical complexes as follows:

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Joint venture partner	Location	Product	Capacity (thousand metric tons per year)
Mobil Oil Corp	Yanbu	ethylene	450
PECTEN Arabian Ltd	Jubail	do	656
Dow Chemical Co	do	do	400
Exxon Corp	do	polyethylene	240
Mitsubishi Gas Chemical Co., Inc., and Japanese consortium	do	methanol	730
Celanese Chemical Co./Texas Eastern Corp	do	do	730

The projects were to be 50-50 ventures between SABIC and its foreign partners. Financing responsibilities were to be divided among the Government (60%), the equity partners (30%), and other sources (10%). Foreign partners were to receive a 5-year tax holiday and crude oil entitlements. Ethane and methane feedstock for the petrochemical complexes was to come from the gas-gathering system under construction by Aramco. The first ethylene complex, that of SABIC/PECTEN, was due onstream in 1982.

Petroleum.—*Production.*—The Government reduced the production ceiling of Aramco from 10.5 million barrels per day in 1977 to 8.5 million barrels per day in 1978. In addition to Aramco's output is production by GOC and AOC, operating onshore and offshore, respectively, in the Partitioned Zone shared with Kuwait. The Government also directed that the output of Arabian Light crude should not exceed 65% of total crude oil production in 1978.

Negotiations for the full takeover of Aramco by the Government continued to be in the final stages in 1977. Under a general accord reached in 1976, Aramco was to change from a concessionaire company to a service company operating in the oil sector as well as in other sectors such as gas exploitation, electrification of Eastern Province, and certain industrial ventures. Aramco would continue to operate and market the bulk of petroleum production, with buying companies receiving crude oil in previous proportions. Petroleum exploration was to be conducted by the companies with their own risk capital; bonuses, fees, and crude oil entitlements were to be received for successful results. At yearend, ownership of Aramco remained with the Government 60%, Exxon Corp. 12%, Texaco 12%, Standard Oil Co. of California 12%, and Mobil 4%.

A $1 billion pressure-maintenance program was to boost petroleum production capacity in Aramco's fields from 11 million barrels per day in 1977 to 14 million barrels per day in 1980. This program included a new saltwater injection system to commence operation in 1978. The Aramco concession covered 222,000 square kilometers and comprised 37 major oilfields, 15 of which were in operation in 1977. The Ghawar Field, rated as the world's largest oilfield, produced approximately 5 million barrels per day of petroleum in 1977. The Zuluf and Marjan Fields were reactivated in 1977 with the construction of one onshore and two offshore gas-oil separation plants and two major pipelines.

Refining.—Petroleum-refining capacity in Saudi Arabia in 1977 was 785,000 barrels per day concentrated in five facilities, as follows:

Company	Location	Startup date	Capacity (thousand barrels per day)
Arabian American Oil Co. (Aramco)	Ras Tanura	1945	600
Getty Oil Co. (GOC)	Mina Saud	1958	100
Arabian Oil Co., Ltd. (AOC)	Ras al-Khafji	1966	30
General Petroleum and Mineral Organization (Petromin)(SARCO).	Jidda	1968	40
Petromin	Riyadh	1975	15

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General Petroleum and Mineral Organization (Petromin) planned expansion of its two refineries and entered into joint ventures for construction of new refining and lubricating oil facilities. The Jidda refinery, owned 75% by Petromin and 25% by Saudi Arabian Refinery Co. (SARCO), was to be expanded from 40,000 barrels to 210,000 barrels per day. The Riyadh refinery was to be expanded from 15,000 barrels to 100,000 barrels per day.

Petromin entered into three joint ventures for construction of petroleum refineries in the new industrial centers of Jubail and Yanbu. Petromin (50%), Standard of California (25%), and Texaco (25%) were to construct a 125,000-barrel-per-day refinery in Jubail. Two 250,000-barrel-per-day refineries were to be constructed, one in Jubail by Petromin (50%) and Shell (50%) and one in Yanbu by Petromin (50%) and Mobil (50%). The refineries were to produce naphtha, gas oil, high- and low-sulfur fuels, jet fuels, and lubricating oil base stocks. Exports were destined primarily for the United States, Western Europe, and Japan.

The Jidda lubricating oil refinery, owned 70% by Petromin and 30% by Mobil, was to begin production in early 1978. Constructed by Kellogg International Corp., the facility was to produce 1 million barrels per year of lubricating oil base stocks, which were previously imported. Petromin Lubricating Oil Co. (Petrolube), also located in Jidda, was to be expanded from a 75,000-barrel-per-year to a 500,000-barrel-per-year blending capacity. Petrolube was also a joint venture of Petromin (70%) and Mobil (30%).

Pipelines.—Aramco completed and put into service 645 kilometers of major hydrocarbon pipelines during 1977. Contracts were awarded for construction of Saudi Arabia's two transpeninsular pipelines to carry crude oil and NGL from Eastern Province to Yanbu on the western coast. Each pipeline would be approximately 1,200 kilometers in length. The crude oil pipeline, to be constructed under the direction of Mobil Overseas Pipeline Co., would carry 1.85 million barrels per day of oil from the Ghawar and Khurais Fields to the projected Yanbu refinery and for export from Red Sea ports. The NGL pipeline, to be constructed under the direction of Gulf Interstate Overseas Co., would carry 250,000 barrels per day of propane, butane, and natural gasoline to Yanbu to be used as feedstock at the planned petrochemical complex and for export.

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[1]Economist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Saudi riyals (SRls) to U.S. dollars at the rate of SRls3.5=US$1.00.

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The Mineral Industry of Sierra Leone

By Candice Stevens[1]

Sierra Leone has experienced slow growth rates in recent years owing to the decline of the mineral sector and the consequent erosion of the country's export base. The closure of the Marampa iron ore mines and the decline in diamond production reduced the contribution of the mineral sector to about 20% of Sierra Leone's gross national product (GNP), estimated at $550 million[2] in 1977. The country's financial situation has deteriorated owing to rising import costs, reduced exports, and a growing Government budget deficit. Sierra Leone's external debt was estimated at $160 million; in 1977, the Government and the International Monetary Fund reached an agreement for credit and foreign exchange support. Sierra Leone maintained a policy of acquiring 51% ownership in all new mining ventures.

Expansion of the mineral sector was to be assisted by improved infrastructure. A network of all-weather roads linking Freetown, the capital, with the provincial capitals and the principal diamond areas was recently completed. The Mano River Union, formed by Sierra Leone and Liberia for economic cooperation, was to undertake improvements in the highway link between Freetown and Monrovia. Construction began in 1977 on a large hydroelectric plant on the Sewa River near Bumbuna. A loan from the International Bank for Reconstruction and Development (IBRD) was to finance improvements in the Freetown electric power generating grid. In 1977, the Government signed a management contract with West African Port Management International (United Kingdom) for overall supervision and upgrading of the Sierra Leone Port Authority.

PRODUCTION AND TRADE

Diamond production declined and bauxite production increased in 1977, Sierra Leone also produced small amounts of nonmetallic minerals and refined petroleum products. Production of iron ore ceased in 1975 owing to the liquidation of Sierra Leone Development Co., Ltd. (DELCO). Rutile production was expected to commence in 1978. Mineral production in Sierra Leone is given in table 1.

In 1977 agriculture displaced the mineral sector as the largest contributor to Sierra Leone's export earnings. The termination of iron ore exports and the decline in diamond exports decreased mineral sector revenue from 70% to 40% of total export value. Although world prices for agricultural products increased significantly and the unit values of diamond and bauxite were higher than in 1976, the balance-of-trade deficit was approximately $25 million owing to the continued high level of imports.

Diamond production was sold to the Central Selling Organization, Diamond Corp. of West Africa Ltd. (DICORWAF), and a small number of licensed buyers. In late 1977, the Government reduced diamond export duties from 7.5% to 2.5% to make legal diamond sales more profitable and reduce smuggling.

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All bauxite was exported unprocessed, principally to Switzerland, the Netherlands, and Canada. Refined petroleum products were exported primarily to Liberia. Overall, the United Kingdom remained Sierra Leone's principal trading partner, supplying 25% of total imports and taking 60% of total exports in 1977.

Table 1.—Sierra Leone: Production of mineral commodities

Commodity[1] and unit of measure	1975	1976	1977[p]
Aluminum, bauxite, gross weight thousand metric tons	655	651	745
Diamond:			
Gem thousand carats	[e]560	433	352
Industrial do	[e]840	650	448
Total do	[e]1,400	1,083	800
Iron ore, gross weight thousand metric tons	1,454	--	--
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	797	231	331
Kerosine do	56	185	199
Jet fuel do	201	109	101
Distillate fuel oil do	304	407	464
Residual fuel oil do	--	423	824
Liquefied petroleum gas do	61	3	10
Refinery fuel and losses do	--	29	6
Total do	1,419	1,387	1,935

[e]Estimate. [p]Preliminary.

[1]In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone) are also produced, but quantities are not reported and available general information is inadequate to make reliable estimates of output levels. Gold production may also occur, but data are not available for estimating production. Sierra Leone annually refines 4,000 to 10,000 metric tons of salt from imported crude marine salt, but this is not included in the body of the table because it would represent a double counting of materials credited to the country where salt was originally collected.

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COMMODITY REVIEW

METALS

Aluminum.—Production of bauxite by Sierra Leone Ore and Metal Co. (SIEROMCO), a wholly owned subsidiary of Alusuisse of Switzerland, was approximately 745,000 tons in 1977. SIEROMCO has mined bauxite in the Mokanji Hills near Moyamba in southwestern Sierra Leone since 1963. Reserves in this region were estimated at 70 million tons of ore containing 47% Al_2O_3 with 4.5% SiO_2. It was confirmed in 1977 that the Sierra Leonean Government would not acquire partial ownership of the Mokanji mine but would increase the taxes and royalties paid by SIEROMCO until 1978 when mining leases were to expire and would be renegotiated.

In 1977, the Sierra Leonean Government and Alusuisse concluded an arrangement for the exploitation of bauxite deposits at Port Loko. The Government was to have a 50% share in the operation and would receive taxes and royalties after an initial 5-year tax holiday. Reserves at Port Loko were estimated at 60 million tons containing 50% Al_2O_3. The mine was to produce 1 million tons of bauxite annually. Alusuisse was also to initiate feasibility studies for an associated alumina refinery with an annual capacity of [500,000] tons.

Iron Ore.—DELCO mined the Marampa iron ore deposits in Port Loko District from 1933 to October 1975 (during which production rose from 24,000 tons to 1.5 million tons), when Sierra Leone joined the Association of Iron Ore Exporting Countries (AIOEC). Agreement was reached in 1977 with the liquidators of DELCO whereby the Sierra Leonean Government would purchase all of DELCO's assets for $1.3 million and would subsequently waive all claims against the liquidators. Negotiations continued between the Government and Bethlehem Steel Corp. (United States), which was considering reopening the Marampa mine and exploiting iron ore reserves at Tonkolili as a joint project.

Titanium Minerals.—Production of rutile at Gbangbama in Moyamba District by Sierra Rutile Ltd. (SRL) was expected to begin in mid-1978. SRL, a joint venture of Bethlehem Steel (85%) and Nord Resources Corp. (15%), invested nearly $50 million in the development of the project, which was to produce between 100,000 and 125,000 tons of rutile annually. Reserves were estimated at 187 million tons of black sands containing 3 million tons of rutile. SRL acquired the Gbangbama leases from Sherbro Miner-

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als Ltd., which was liquidated in 1971 after preliminary development of the project. Work continued in 1977 on construction of a new dredge and concentrating plant, powerplant enlargement, machine and electrical shop extensions, and rehabilitation of the mine camp.

A joint subsidiary of the West German firms Bayer A.G. and Preussag Metall A.G. continued exploratory drilling in the region of Bradford and Rotifunk for titanium minerals. Bayer-Preussag acquired a 5-year exclusive prospecting license in a 6,700-square-kilometer area of Southern Province in 1974. Approximately 20,000 tons of raw material was extracted for treatment and evaluation at a pilot plant constructed in their rutile concession in 1976.

NONMETALS

Diamond.—Diamond production in 1977 again declined to a low of approximately 800,000 carats. National Diamond Mining Co. (DIMINCO), which accounted for the major share of diamond production, suffered severe production declines in recent years owing to the exhaustion of alluvial reserves. Two processing plants were closed in 1977, and several hundred workers were put out of work. DIMINCO initiated prospecting in new areas in southern Sierra Leone, but development of additional reserves would require extensive capital investment. DIMINCO was created in 1970 when the Government purchased 51% of Sierra Leone Selection Trust Ltd., a subsidiary of Consolidated African Selection Trust. In 1977, DIMINCO mined lower grade deposits in its two concession areas in the Yengema region of Kono District and the Tongo region south of Yengema. One-half of DIMINCO's production was sold to DICORWAF, a subidiary of De Beers Consolidated Mines Ltd.; five licensed buying firms received fixed percentages of the remainder of output.

The balance of diamond production was under the Alluvial Diamond Mining Scheme (ADS), established in 1956 to discourage illicit digging. Licenses were issued to Sierra Leonean nationals or to firms holding a Sierra Leonean majority for individual diamond digging in 23,000 square kilometers of designated area outside the DIMINCO concessions. The ADS provided jobs for about 40,000 diggers, who for the most part recovered diamond by primitive hand-panning methods.

MINERAL FUELS

Petroleum.—Sierra Leone Petroleum Refining Co., whose refinery opened in Freetown in 1976, produced over 1.9 million barrels of refined petroleum products in 1977. Crude oil was imported primarily from Nigeria. The refinery was jointly owned by the Sierra Leonean Government and five oil companies: British Petroleum Co. Ltd., Texaco Inc., Shell Oil Co., Mobil Oil Corp., and Agip S.p.A. Approximately 20% of production was exported. Exploration for petroleum in offshore Sierra Leone was minimal in 1977; most prospecting licenses had been allowed to expire because previous exploration had yielded no commercial petroleum or natural gas deposits.

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[1]Economist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Sierra Leonean leones (Le) to U.S. dollars at the rate of Le87 = US$1.00.

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The Mineral Industry of the Republic of South Africa

By Miller W. Ellis[1] and Charles W. Sweetwood[2]

The mining industry made a substantial contribution to the economy of the Republic of South Africa during 1977, and industries based on mineral products supported the country's position as the leading commercial and manufacturing nation of the African continent. Mineral products accounted for more than 17% of the gross domestic product (GDP) and more than half of export sales. Both the quantity and value of local mineral sales increased substantially, and the value of mineral imports (excluding petroleum) decreased 31.6% in conformity with the Government's program of selective imports of essential ores, concentrates, and metals. At current prices the value of mineral products exceeded $6 billion for the first time, contributing a total of $6.61 billion (R5.75 billion)[3] to a GDP of $38.23 billion (R33.24 billion) in 1977, compared with $5.38 billion (R4.68 billion) (revised) of the 1976 GDP of $33.37 billion (R29.02 billion). The value of mineral production increased nearly 23%, while the GDP increased 14.5% above the 1976 record. The quantity of mineral exports in 1977 was more than double that of 1976, largely owing to the increased facilities for bulk loading of iron ore and coal at the new ports of Saldanha Bay and Richards Bay, respectively, but the total value of mineral exports increased by less than 25%. Because of the Government's selective policy, imports of mineral commodities decreased 50% in quantity and 32% in value.

Expansion programs in both the Government-controlled and privately owned mineral industries continued on or ahead of schedule during 1977. The Government-controlled South African Iron and Steel Industrial Corp., Ltd. (ISCOR) operated the new ore-loading terminal at Saldanha Bay throughout the year, and the South African Coal, Oil and Gas Corp., Ltd. (SASOL) completed development of its new Secunda Colliery and accelerated construction at the SASOL II oil-from-coal plant. The flexibility of Government policy of providing incentives to stimulate investment in mining was demonstrated by negotiations with De Beers Consolidated Mines Ltd. for more favorable leasing arrangements and reduced taxes, contingent on additional capital for deeper development work at the Premier diamond mine.

PRODUCTION

The Republic of South Africa continued to lead the world in production of chromite, gem diamond, gold, platinum, vanadium, and vermiculite, and was one of the top three producers of antimony, asbestos, industrial diamond, manganese, and uranium. Facilities at the new Saldanha Bay and Richards Bay ports provided capacity for increased production of iron ore and coal to be exported. Important quantities of cement, copper, fluorspar, phosphate, salt, tin, and zinc were produced for export as well as to supply domestic industries. Production of gold and manganese ore declined, but production of gem and industrial diamond, platinum-group metals, silver, chromite, fluorspar, and many of the country's other mineral commodities increased during 1977. Details of mineral production are shown in table 1.

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Table 1.—Republic of South Africa: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Aluminum metal	75,900	78,400	78,000
Antimony concentrates:			
Gross weight	26,160	18,341	20,053
Metal content	15,924	10,698	11,535
Beryllium, beryl concentrate, 11% to 12% BeO	3	3	3
Chromium, chromite, gross weight:			
More than 48% Cr_2O_3	15,230	25,594	53,433
44% to 48% Cr_2O_3	1,127,519	1,311,894	1,765,506
Less than 44% Cr_2O_3	932,629	1,071,747	1,499,885
Total	2,075,378	2,409,235	3,318,824
Copper:			
Mine output, metal content	178,927	196,880	205,414
Metal:			
Smelter	[r]166,800	168,100	188,400
Refined	[r]92,400	102,400	145,900
Gold, primary thousand troy ounces	22,938	22,936	22,502
Iron and steel:			
Iron ore and concentrate thousand tons	12,298	15,663	26,481
Pig iron do	5,177	5,795	6,114
Ferroalloys (blast and electric furnace):			
Ferrochromium[e] do	299	350	380
Ferromanganese[e] do	337	350	400
Ferrosilicon[e] do	76	79	100
Ferrosilicomanganese[e] do	15	22	25
Ferrosilicochrome[e] do	21	22	29
Ferrovanadium[e] do	(1)	(1)	(1)
Total do	748	823	934
Crude steel:			
Ingots do	6,367	6,926	7,175
Castings do	213	230	201
Total do	[r]6,580	7,156	7,376
Semimanufactures:			
Semis for sale do	140	250	538
Hot-rolled products do	4,472	4,700	4,844
Iron castings do	511	[e]476	[e]365
Steel castings and forgings do	124	142	133
Total do	[r]5,247	5,569	5,880
Lead mine output, metal content	2,704	--	--
Manganese ore and concentrate, gross weight:			
Metallurgical:			
Over 48% Mn	199,274	269,608	262,965
Over 45% to 48% Mn	1,379,230	1,517,353	1,197,748
Over 40% to 45% Mn	232,947	209,346	576,894
Over 30% to 40% Mn	3,872,052	3,358,080	2,838,758
Subtotal	5,683,503	5,354,387	4,876,365
Chemical:			
Over 65% MnO	6,849	2,733	156
Over 35% to 65% MnO	78,680	95,138	171,434
Subtotal	85,529	97,871	171,590
Total	5,769,032	5,452,258	5,047,955
Manganiferous iron ore, 15% to 30% Mn, 20% to 35% Fe	111,703	50,964	242,155
Nickel:			
Mine output, metal content	20,754	22,371	21,955
Electrolytic metal	14,000	17,000	17,200
Platinum-group metals, content of concentrate, matte, and refinery products[e 2] thousand troy ounces	2,600	2,700	2,870
Silver metal, primary do	3,084	2,821	3,130
Tin:			
Concentrate:			
Gross weight	5,652	5,655	6,139
Metal content	2,643	2,799	2,864
Metal, primary	780	683	582
Uranium oxide U_3O_8	2,934	[r]3,255	3,962

See footnotes at end of table.

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Table 1.—Republic of South Africa: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS —Continued			
Vanadium:			
Vanadiferous slag, gross weight	41,690	45,061	48,518
Vanadium content of:			
Vanadiferous slag produced[e]	5,837	6,309	6,793
Vanadium pentoxide and vanadate products[e]	4,808	3,566	4,445
Total	10,645	9,875	11,238
Zinc:			
Concentrate:			
Gross weight	127,624	149,922	139,262
Metal content	63,812	74,961	69,631
Smelter	63,700	66,200	76,000
Zirconium concentrate (baddeleyite)	11,594	11,252	16,825
NONMETALS			
Asbestos:			
Amosite	88,411	78,898	66,983
Anthophyllite	1,912	1,506	550
Chrysotile	99,660	111,025	111,575
Crocidolite	164,727	178,411	201,056
Total	354,710	369,840	380,164
Barite	795	1,915	2,500
Cement, hydraulic thousand tons	7,176	7,048	6,573
Clays:			
Bentonite	37,549	39,602	37,221
Fire clay	294,086	207,195	167,835
Flint clay	255,100	190,731	193,229
Kaolin	56,808	59,733	88,619
Corundum, natural	241	142	138
Diamond:			
Gem thousand carats	3,435	3,340	3,628
Industrial do	3,860	3,683	4,015
Total do	7,295	7,023	7,643
Diatomite	649	619	666
Feldspar	30,354	46,138	51,230
Fertilizer materials, crude, natural phosphate rock thousand tons	11,626	11,769	14,583
Fluorspar:			
Acid grade	172,270	210,874	234,649
Ceramic grade	10,294	39,502	65,660
Metallurgical grade	20,019	40,342	50,370
Total	202,583	290,718	350,679
Gem stones, semiprecious:			
Emerald crystals kilograms	2,375	1,494	2,076
Tiger's eye do	187,175	206,210	339,557
Graphite	523	530	911
Gypsum, crude	538,622	482,375	439,688
Kyanite and related materials:			
Andalusite	77,149	77,464	113,076
Sillimanite	16,911	25,733	15,455
Lime[3] thousand tons	1,328	1,387	1,504
Magnesite, crude	61,202	62,858	49,219
Mica:			
Sheet kilograms	--	220	45
Waste	2,511	2,380	2,890
Pigments, mineral, natural:			
Ochers	1,368	1,288	1,561
Oxides	1,361	755	609
Umber	556	368	--
Pyrite, gross weight	650,738	735,110	829,509
Quartz, quartzite, glass sand (silica)	1,155,503	1,225,413	1,016,928
Salt	264,412	223,662	242,254
Silcrete	8,086	5,979	4,340

See footnotes at end of table.

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Table 1.—Republic of South Africa: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976	1977[p]
NONMETALS —Continued				
Stone, sand and gravel, n.e.s.:				
Dimension stone:				
Granite:[3]				
Sawn slabs		33,576	32,316	24,084
Rough blocks		282,341	263,367	388,719
Marble		21,839	16,220	8,523
Crushed and broken:				
Limestone[3]	thousand tons	13,737	13,739	13,076
Shale	do.	393	369	267
Sulfur:				
Content of pyrite	do.	260	294	332
Byproduct:				
From metallurgy	do.	80	91	105
From petroleum	do.	25	27	28
Total	do.	365	412	465
Talc and related materials:				
Pyrophyllite (wonderstone)		6,782	5,784	5,109
Talc		9,236	7,039	8,095
Vermiculite		207,529	222,077	165,419
MINERAL FUELS AND RELATED MATERIALS				
Carbon black[e]		40,400	43,100	45,000
Coal:				
Anthracite	thousand tons	1,591	2,459	2,559
Bituminous	do.	67,849	74,600	82,852
Total	do.	69,440	77,059	85,411
Coke:				
Oven and beehive	do.	4,443	4,608	5,201
Gashouse, low- and medium-temperature[e]	do.	[r]105	[r]110	110
Petroleum refinery products:				
Gasoline	thousand 42-gallon barrels	31,939	29,783	30,083
Jet fuel	do.	3,144	2,196	2,349
Kerosine	do.	3,400	3,132	3,338
Distillate fuel oil	do.	30,220	31,279	31,918
Residual fuel oil	do.	29,454	22,027	22,036
Lubricants	do.	2,171	2,228	2,262
Other	do.	7,715	8,581	8,607
Refinery fuel and losses	do.	6,651	5,561	5,624
Total	do.	114,694	104,787	106,217

[e]Estimate. [p]Preliminary. [r]Revised.
[1]Less than 1/2 unit.
[2]Data include osmiridium from gold ores estimated at 2,500 troy ounces annually.
[3]Local sales plus exports. Production not reported.

TRADE

The Republic of South Africa continued to be a major source of mineral products for the industries of Western Europe, Japan, and the United States. Exports of chromium, fluorspar, asbestos, platinum, uranium, vanadium, and zirconium all showed significant increases. Coal shipments doubled, and iron ore was exported at nearly three times the 1976 rate. Gold continued to provide a large share of the country's foreign exchange, but both gem and industrial diamonds made substantial contributions. The country's industrial, railway, and port facilities continued to contribute to the importance of the mineral industries of other countries of Southern Africa. Crude oil and alumina were major mineral imports. Details of exports from and imports to the Republic are shown in tables 2 and 3, respectively. Table 4 compares the value of exports and local sales for 1976 and 1977.

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Table 2.—Republic of South Africa: Exports of selected mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976
METALS			
Aluminum metal, unwrought[2]	13,900	13,700	20,400
Antimony ore and concentrate, gross weight	22,530	12,247	18,115
Beryllium, beryl concentrate, gross weight	--	15	--
Chromium:			
Chromite ore and concentrate, gross weight:			
Chromium oxide content 44% or less[3]	489,086	473,603	366,372
Chromium oxide content over 44% to 48%[3]	291,676	433,648	231,103
Chromium oxide content over 48%[3]	73	--	50
Total	780,835	907,251	597,525
Chromite sand, gross weight:			
Chromium oxide content 44% or less[3]	9,146	40,480	203,060
Chromium oxide content 44% to 48%[3]	272,486	301,674	393,698
Chromium oxide content over 48%[3]	--	--	--
Total	281,632	324,154	[3]596,758
Copper:			
Ore and concentrate, metal content[2 4]	17,000	19,500	23,600
Blister and anode[2]	65,400	61,700	69,400
Refined[2]	26,200	37,600	45,600
Iron and steel:			
Iron ore, gross weight:			
Hematite[e 3] thousand tons	2,119	2,523	3,663
Magnetite[3 e] do.	775	814	550
Total do.	2,894	3,337	4,213
Scrap[5] do.	([e])	6	3
Pig iron[5] do.	179	1	1
Sponge iron and powder[5] do.	19	16	31
Ferroalloys:			
Ferrochromium[5]	194,800	283,700	340,600
Ferromanganese[5]	346,900	276,000	330,300
Ferrosilicon[5]	40,100	36,100	59,600
Other[5]	38,800	34,100	41,700
Total	620,600	629,900	772,200
Ingots and other primary forms[5]	[r]100,400	31,300	182,800
Semimanufactures:[5]			
Bars and rods	71,100	27,100	131,600
Angles, shapes, sections	65,600	45,300	106,600
Plate and sheet	286,400	170,900	459,900
Hoop, strip, coil	28,100	5,100	9,800
Rails and accessories	31,600	20,600	14,000
Wire	8,500	5,600	10,300
Tubes, pipes, fittings (including cast pipe)	15,700	12,400	16,700
Castings and forgings	4,900	5,400	3,900
Total	[r]511,900	[r]292,400	752,800
Lead, unwrought metal[2 5]	31,900	27,100	16,700
Manganese ore, gross weight:			
Metallurgical[e 3]	3,020,892	3,401,376	3,446,435
Chemical[e 3]	710	1,327	215
Manganiferous[e 3]	116,859	237,684	295,350
Total[e 3]	3,138,461	3,640,387	3,742,000
Nickel, unwrought[e 3]	14,434	17,895	19,200
Platinum-group metals, metal including alloys, all forms[e 3] thousand troy ounces	1,679	1,831	NA
Tin concentrate	1,768	2,273	1,768
Vanadium materials, V_2O_5 equivalent	11,600	--	12,885
Zinc:			
Concentrates, gross weight	39,422	66,706	86,048
Metal, unwrought[2]	--	3,000	7,000
Zirconium, baddeleyite ore and concentrate	6,256	4,102	NA
NONMETALS			
Asbestos:			
Amosite	90,109	173,165	66,978
Anthophyllite and/or tremolite	484	1,406	818
Chrysotile	71,669	112,415	81,056
Cape blue	159,029	257,273	170,412
Transvaal blue	610	--	--
Total	321,901	544,259	319,264

See footnotes at end of table.

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Table 2.—Republic of South Africa: Exports of selected mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976
NONMETALS —Continued			
Cement[e] thousand tons	354	343	--
Clay and clay products:			
Bentonite:			
Crude	1,675	1,595	1,786
Processed	101	158	20
Fire clay, calcined	--	--	--
Flint clay:			
Raw	678	2,443	8,911
Calcined	149,729	114,319	77,977
Fuller's earth	21	--	--
Kaolin:			
Crude	1,804	114	--
Milled	240	490	--
Washed	91	30	117
Feldspar	3,558	1,878	3,247
Fertilizer materials (phosphate rock):			
Ore	7,000	--	--
Concentrate	30,097	13,229	11,118
Fluorspar:			
Acid grade	111,382	126,061	178,479
Ceramic grade	--	39	28,845
Metallurgical grade	12,206	454	8,591
Total	123,588	126,554	215,915
Gem stones (emerald crystals) kilograms	1,963	1,045	900
Graphite (processed)	954	434	--
Gypsum	10,165	14,069	11,400
Kyanite and related materials:			
Andalusite	18,759	23,773	16,357
Sillimanite	18,737	16,524	12,960
Lime, slaked and other	41,902	41,809	39,612
Mica:			
Waste	2,535	510	244
Ground	2,037	2,542	932
Pigments, mineral:			
Ochers	1,601	896	607
Oxides	183	22	10
Salt	10,133	6,770	19,596
Stone, sand and gravel:			
Dimension stone:			
Granite:			
Sawn slabs	6,915	5,660	14,066
Raw blocks	305,813	225,746	207,409
Marble cubic meters	4,887	2,097	3,141
Quartzite:			
Tiles	935	5,046	780
Other	20	16	--
Limestone	18,867	10,092	6,854
Slate:			
Dust	--	--	478
Tiles	2,618	2,221	2,490
Other	665	190	1,612
Silica:			
Crude	186	40	5
Processed	1,231	497	381
Sulfur, pyrites, sulfur content	--	--	--
Talc and related materials:			
Talc and steatite	214	116	--
Wonderstone (pyrophyllite)	5,335	3,367	3,834
Vermiculite	149,665	185,943	187,416
MINERAL FUELS AND RELATED MATERIALS			
Coal:			
Anthracite thousand tons	1,035	1,122	4,431
Bituminous do	1,245	1,565	1,530

[e]Estimate. [r]Revised. NA Not available.

[1]Because official South African trade statistics provide data only on the total value of exports of each commodity class (no data on quantity and no data on destinations), this table has been compiled from several sources and includes some estimates. All information not individually footnoted is from the quarterly publication "Minerals" issued by the Department of Mines of South Africa (various issues 1974-78). Figures from other sources and Bureau of Mines estimates are individually footnoted.

[2]World Bureau of Metal Statistics. World Metal Statistics, October 1979. London, 1979, 112 pp.

[3]American Consulate General, Johannesburg, Republic of South Africa. Various airgrams.

[4]Includes exports from the Territory of South-West Africa (Namibia) in source publication; no basis is available for distribution of this total between the Republic of South Africa and the Territory of South-West Africa.

[5]United Kingdom Iron and Steel Statistics Bureau. International Steel Statistics - Republic of South Africa. Issues for 1974, 1975, 1976, 1977, and 1978, except data for individual types of ferroalloys for 1977 are Bureau of Mines estimates.

[6]Less than 1/2 unit.

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Table 3.—Republic of South Africa: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite	32,130	13,248	Austria 6,884; Denmark 4,680.
Oxide and hydroxide	140,499	165,347	Mainly from Austria.
Metal including alloys:			
Scrap	356	875	United States 369; West Germany 198.
Unwrought	1,264	633	United Kingdom 160; Japan 111.
Semimanufactures	12,284	9,410	United States 4,166; Belgium-Luxembourg 1,050.
Arsenic:			
Oxides and acids	105	90	Mainly to United Kingdom.
Metal	2	17	NA.
Chromium:			
Chromite	80,070	167,125	NA.
Oxide and hydroxide	296	326	West Germany 110; U.S.S.R. 62; United States 25.
Cobalt oxide and hydroxide	16	12	Canada 10.
Copper:			
Ore and concentrate	11,076	8,827	Mainly from Austria.
Metal including alloys:			
Scrap	369	709	United Kingdom 77.
Unwrought	4,221	3,776	NA.
Semimanufactures	5,966	3,940	United Kingdom 1,086; West Germany 1,029.
Gold metal, unworked or partly worked troy ounces	9,196	8,533	United Kingdom 4,884; Switzerland 1,037; West Germany 1,017.
Iron and steel:			
Ore and concentrate	8,244	2	NA.
Metal:			
Scrap	18,022	34,261	NA.
Pig iron, ferroalloys, similar materials	48,530	87,940	Sweden 2,744; Norway 925.
Steel ingots and other primary forms	144,227	10,892	Japan 1,027; United Kingdom 276.
Semimanufactures:			
Bars and rods	54,609	15,049	United Kingdom 7,131; West Germany 1,548.
Angles, shapes, sections	50,641	5,705	United Kingdom 2,371; Belgium-Luxembourg 1,607.
Plates and sheets	399,884	47,441	Japan 32,510; West Germany 4,101.
Hoop and strip	13,935	8,830	Japan 2,609; West Germany 667.
Rails and accessories	181,167	43,194	West Germany 29,913.
Wire and wire rod	15,888	10,423	Japan 1,916; West Germany 1,637.
Tubes, pipes, fittings	68,509	112,117	Japan 25,890; West Germany 13,343.
Castings and forgings, rough	4,176	4,128	United Kingdom 1,222; Belgium-Luxembourg 514.
Total	788,809	246,887	
Lead:			
Ore and concentrate	1,004	5,766	Mainly from Australia.
Metal including alloys:			
Scrap	8,299	12,744	Canada 6,843; United States 2,554.
Unwrought	3,297	5,009	NA.
Semimanufactures	68	36	NA.
Magnesium metal including alloys, all forms	576	539	United States 268.
Manganese:			
Ore and concentrate	83	311	United Kingdom 203.
Oxides	1,323	3,870	Mainly from Belgium-Luxembourg.
Mercury 76-pound flasks	2	1	All from Spain.
Molybdenum metal including alloys, all forms	24	18	Mainly from Australia.
Nickel metal including alloys, all forms	2,450	1,784	United Kingdom 378; Japan 120.
Platinum-group metals including alloys, all forms troy ounces	71,392	16,804	United States 6,299; West Germany 3,472.
Silicon and tellurium	60	14	Mainly from United Kingdom.
Silver:			
Waste and sweepings troy ounces	5,168	35,619	United States 17,014; West Germany 2,028.
Metal including alloys, all forms do.	4,000,070	1,599,714	Mainly from West Germany.
Tin:			
Oxides	14	16	Mainly from United Kingdom.
Metal:			
Scrap	23	86	NA.
Unwrought and semimanufactures	898	850	NA.
Titanium (ilmenite):			
Ore and concentrate	3	221	Mainly from Australia.
Oxides	71	209	Belgium-Luxembourg 87; West Germany 82.
Tungsten:			
Ore and concentrate	422	341	Mainly from Brazil.
Metal including alloys, all forms	33	13	West Germany 5; United Kingdom 2.

See footnotes at end of table.

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Table 3.—Republic of South Africa: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Zinc:			
Ore and concentrate	20,704	22,095	Canada 15,464; Australia 4,930.
Oxides	386	396	West Germany 148; United Kingdom 144.
Metal including alloys:			
Scrap including powdered dust	306	320	Canada 36.
Semimanufactures	59	34	West Germany 18.
Zirconium, ore and concentrate	49	232	Australia 274.
Other:			
Ore and concentrate:			
Molybdenum, tantalum, vanadium	76	34	All from United States.
Other base metals, n.e.s	2,884	2,226	Mainly from Australia.
Ash and residue containing nonferrous metals	9,610	22,915	United Kingdom 6,186; Australia 4,557; West Germany 3,351.
Oxides, hydroxides, peroxides of metals, n.e.s	346	515	Mainly from United States.
Elemental boron, phosphorus, and selenium	104	83	United Kingdom 42.
Metal including alloys, all forms:			
Alkali, alkaline-earth, rare-earth metals	2,118	1,919	NA.
Pyrophoric alloys	7	6	West Germany 2.
Base metals including alloys, all forms, n.e.s	585	404	United Kingdom 227.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	6,331	491	NA.
Grinding and polishing wheels and stones	570	439	United Kingdom 124.
Asbestos	28,560	30,428	NA.
Barite	2,718	2,685	West Germany 562; Israel 482; United Kingdom 305.
Boron materials and crude natural borates	467	450	Turkey 250; United States 150.
Bromine	6	6	West Germany 5.
Cement	70,307	73,754	Belgium-Luxembourg 9,953; West Germany 1,290.
Chalk	6,827	3,680	France 2,683; United Kingdom 512.
Clays and clay products:			
Crude clays and refractory minerals	16,234	26,943	United Kingdom 11,827; United States 10,250.
Products:			
Refractory	30,298	21,458	West Germany 5,802; United States 5,161.
Nonrefractory	2,779	3,284	NA.
Cryolite and chiolite	90	131	Denmark 118.
Diamond:			
Gem carats	83,000	40,000	United Kingdom 22,000; Belgium-Luxembourg 7,500.
Industrial thousand carats	9,044	6,709	United Kingdom 5,743.
Diatomite and other infusorial earth	8,745	4,922	United States 4,077.
Feldspar, leucite, nepheline syenite	95	135	NA.
Fertilizer materials:			
Crude:			
Nitrogenous	NA	23	NA.
Phosphatic	1,810	74	NA.
Potassic	249,809	205,279	West Germany 47,908; Canada 29,901; Spain 21,963.
Other	1,534	260	NA.
Manufactured:			
Nitrogenous	94,217	47,419	Italy 35,750; Netherlands 3,301.
Phosphatic	375	9,425	Mainly from United States.
Potassic	22,402	11,613	West Germany 2,100; Canada 500.
Other including mixed	1,086	866	Netherlands 516; Belgium-Luxembourg 240.
Graphite, natural	894	480	Norway 282; Sri Lanka 60.
Gypsum and plasters	5,616	5,826	West Germany 4,098; Spain 990.
Lime	1,389	4,762	France 3,693.
Lithium minerals not further described	2,273	5,880	NA.
Magnesite	137,568	103,814	Italy 11,940; Japan 9,378; United Kingdom 4,314.
Mica:			
Crude, including splittings and waste	423	773	NA.
Worked, including agglomerated splittings	50	58	United Kingdom 25.
Pigments, mineral:			
Natural, crude	536	705	Austria 575; United Kingdom 93.
Iron oxides, processed	2,364	4,294	West Germany 2,364.
Precious and semiprecious stones, except diamond value, thousands	$2,059	$5,093	Ireland $422; West Germany $83.
Pyrite	31	47	NA.
Salt	48,491	46,496	Australia 45,309.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	58,633	38,801	West Germany 16,022; United Kingdom 12,971.
Caustic potash	1,228	704	West Germany 327; France 146.
Stone, sand and gravel:			
Crude and partly worked:			
Calcareous	1,282	881	Italy 643; Israel 76; Portugal 73.

See footnotes at end of table.

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Table 3.—Republic of South Africa: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Stone, sand and gravel —Continued			
Crude and partly worked —Continued			
Slate	38	853	NA.
Other	12,384	14,991	NA.
Worked:			
Gravel and crushed stone	39,343	80,565	NA.
Quartz and quartzite	54	120	NA.
Sand, excluding metal bearing	289	7,583	Canada 7,174.
Sulfur:			
Elemental:			
Other than colloidal	260,117	451,480	Canada 292,896; Virgin Islands 38,846.
Colloidal	713	1,342	United States 954; West Germany 247.
Sulfur dioxide	2	(1)	NA.
Sulfuric acid	24,118	480	NA.
Talc and steatite	1,654	2,133	Republic of Korea 819; Norway 476.
Other nonmetals, n.e.s.:			
Crude	4,275	4,814	Greece 2,923; Australia 1,450.
Slag, dross, and similar waste, not metal bearing:			
From iron and steel manufacture	32,225	28,025	Mainly from Canada.
Slag and ash, n.e.s	36	135	United States 26.
Oxides and hydroxides of magnesium, strontium, barium	388	524	United States 290.
Iodine and fluorine	3	10	Belgium-Luxembourg 4; Japan 4.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals	2,112	1,517	Austria 958; United Kingdom 106.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	998	1,154	United States 337.
Carbon and carbon black	2,651	3,208	United States 1,471; Canada 751.
Coal, all grades, including briquets	130,194	302,894	United States 84,487.
Coke and semicoke	--	2,575	All from France.
Gas, hydrocarbon, natural	35	464	West Germany 66; United States 11.
Hydrogen and rare gases	36	45	Japan 19; United States 13.
Peat	394	348	West Germany 139; Norway 14.
Petroleum refinery products:			
Mineral jelly and wax, thousand 42-gallon barrels	237	327	West Germany 101; United States 53; Japan 26.
Bitumen and other residues, 42-gallon barrels	6,393	4,181	Netherlands 3,042; United States 921.
Bituminous mixtures, n.e.s.—do	5,502	14,126	United States 5,963; United Kingdom 679.
Pitch—do	14,740	3,069	United States 1,782; United Kingdom 1,232.
Petroleum coke—do	162,371	87,093	United Kingdom 64,801.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	68	29	NA.

NA Not available.
[1]Less than 1/2 unit.

Table 4.—Republic of South Africa: Value of domestic sales and exports of major mineral commodities

(Thousand dollars)

Commodity	Domestic sales		Exports	
	1976	1977	1976	1977
METALS				
Aluminum	55,828	80,913	17,480	22,080
Antimony	5,752	9,941	19,926	9,771
Chromium ore[1]	25,537	40,488	44,430	72,836
Copper	64,933	60,628	132,690	177,015
Gold[2]	--	--	2,737,197	3,237,240
Iron ore[1]	31,050	41,608	60,853	194,741
Manganese ore[1]	24,099	24,837	126,906	110,378
Nickel	14,830	13,983	77,883	86,410
Platinum-group metals[2]	--	--	459,620	465,183
Silver	12,210	14,498	0	0
Tin	5,806	6,640	10,960	21,096
Uranium	--	--	70,315	104,424
Vanadium	8	22	57,195	60,524
Zinc	10,552	13,143	15,143	9,454
Zirconium	0	1	1,084	2,645

See footnotes at end of table.

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Table 4.—Republic of South Africa: Value of domestic sales and exports of major mineral commodities —Continued

(Thousand dollars)

Commodity	Domestic sales		Exports	
	1976	1977	1976	1977
NONMETALS				
Andalusite	2,741	3,757	1,230	7,144
Asbestos	6,581	4,696	128,705	153,642
Cement[3]	134,895	154,971	6,831	13,225
Diamonds[2]	--	--	247,334	296,232
Other gems	191	289	925	889
Feldspar	1,281	1,343	200	137
Fluorspar	1,616	1,669	15,954	18,542
Gypsum	1,882	1,837	164	113
Kaolin[4]	1,600	1,732	37	22
Other clays[4]	4,393	5,135	2,802	4,187
Limestone	27,911	32,497	109	65
Lime products[3]	28,760	38,148	1,042	1,054
Magnesite	1,819	1,685	--	--
Mica	68	77	274	502
Phosphate	30,351	51,196	199	114
Pyrite (sulfur)	10,506	11,781	0	0
Salt	6,640	8,491	508	379
Shale	559	351	--	--
Silica	8,656	8,475	50	187
Sillimanite	91	181	1,414	1,717
Slate	1,156	994	580	383
Stone	2,307	3,719	11,001	17,311
Talc	386	436	0	12
Vermiculite	183	214	7,000	6,526
Wonderstone	302	328	463	108
MINERAL FUELS				
Anthracite	12,854	13,207	34,395	56,691
Bituminous coal	463,658	569,676	84,546	229,143
Carbon black	7,820	8,280	--	--
MISCELLANEOUS				
Other minerals	533	580	363	151
Total	1,010,274	1,232,448	4,377,749	5,382,270

[1]Value of ore only; does not include iron, steel, or ferroalloys.
[2]Total value including domestic sales, if any.
[3]Includes value of raw materials reported separately.
[4]Includes both crude and processed material.

Source: Republic of South Africa Department of Mines. Quarterly Information Circular, Minerals. October-December 1977, pp. 1, 2, and 31-34.

COMMODITY REVIEW

METALS

Aluminum.—The Republic of South Africa continued to import all its bauxite and alumina. Nearly 155,000 tons of alumina came from the Alusuisse operation near Gove, Australia, to the Richards Bay refinery of Alusaf (Pty.) Ltd., owned 35% by the Government's Industrial Development Corp. Ltd. and 20% by Alusuisse. Alusaf produced 74,100 tons of aluminum as liquid metal and ingots, and its adjacent affiliate, Alustang (Pty.) Ltd., produced redraw rod and solid sector aluminum for electric cable. Alusaf's ingot prices increased from $1,216 per ton to $1,282 per ton f.o.b. Richards Bay in 1977. Approximately half Alusaf's ingot production was sold to Huletts Aluminium Ltd. (Hulamin) at Pietermaritzburg in Natal, which produced flat and coil sheets, extruded shapes, cable, and aluminum paste for paint. In September 1977 Hulamin commissioned a $28.8 million sheet mill to produce approximately 4,000 tons of thin sheet aluminum per year. Hulamin's gross income increased from $72 million in 1976 to about $87 million in 1977

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and was expected to reach nearly $100 million in 1978.

Imports of aluminum metal products, mostly from the United States, decreased from 10,918 tons in 1976 to 8,047 tons in 1977. Japan and the United Kingdom were the principal suppliers of some 5,000 tons of abrasive and activated alumina. Most of the country's requirements of 24,000 tons of raw and activated bauxite for the chemicals, refractories, and abrasives industries came from Australia, and Denmark and Italy supplied approximately 1,000 and 1,500 tons, respectively. In October 1977, a new private sector company, South African Bauxite Ltd., was investigating low-grade bauxite deposits near Weza, 150 kilometers west of Durban.

Antimony.—All of the country's antimony production continued to come from seven mines operated by Consolidated Murchison Ltd. (CML) located along the Murchison Range, north and northwest of the Palabora copper mine. Ore and concentrate production increased from 642,800 and 18,341 tons, respectively, in 1976 to 671,900 and 20,053 tons in 1977. The sharp decline in exports of concentrate from 18,115 tons in 1976 to 8,452 tons in 1977 was attributed to the increased manufacture of service-free automotive-type storage batteries that use antimony-free lead. Domestic sales of antimony increased from nearly 6,000 tons in 1976 to more than 8,000 tons in 1977, much of which was sold to the Antimony Products (Pty.) Ltd. (APL) plant on CML property at Gravelotte in northern Transvaal. The APL plant, jointly owned by CML, Chemtron Corp. of Chicago, and Johannesburg Consolidated Investment Co. Ltd., has the capacity to produce 3,265 tons of crude antimony oxide annually and manufactures a fire retardant, largely for export. CML reported favorable results from preliminary tests of a pilot plant to produce high-purity antimony sulfide concentrate from the previously unsalable high-arsenic portion of CML's concentrate and ore.

Chromite.—Production of chromite increased 38% from 2.4 million tons in 1976 to 3.3 million tons in 1977. Domestic sales increased 38% in quantity and nearly 61% in value, while export quantity rose more than 50% with a value increase of nearly 110% to more than $45 million. Estimates indicated a slight decrease in exports of chrome sand, a small increase in local sales, and a 21% increase in export value to more than $27.5 million. In line with the general increase in world market prices, the average value realized for chromite exports increased 36% from $36 per ton in 1976 to $49 per ton in 1977.

The South African Railways and Harbors Administration (SAR&H) and the country's 16 chromite producers advanced a loan to the Mozambique Government early in 1977 to purchase new bulk-loading equipment for the port of Maputo. Technical and managerial expertise was also provided, and by the end of March, South African chromite was moving smoothly through the port. The converted, privately owned, grain-loading facility at Island View in Durban harbor was utilized for chrome sand outloading. With both ports operational, the industry was able to handle enhanced export orders following the repeal of the Byrd Amendment in March 1977.

Copper.—The depressed world market prices and rising operating costs during 1977 did not seriously affect the South African copper industry. Ore production increased 7.3% over that of 1976, and the output of concentrate and metal rose 5.8%. Exports increased 10% in quantity and 33.5% in value, but domestic sales declined nearly 25% from 62,048 tons in 1976 to 46,655 tons in 1977. Imports of metal were deliberately reduced 69% from 11,724 tons in 1976 to only 3,601 tons in 1977. The O'okiep Copper Co. Ltd., near Springbok in northwestern Cape Province, suffered considerable financial loss during 1977 and by July 1 announced curtailment of development work, a production cut of 27%, and a 35% reduction in work force. Priska Copper Mines Pty. Ltd., jointly owned by the Anglo Transvaal Consolidated Investment Co. Ltd. and U.S. Steel Corp., managed to maintain operating costs and increase overall production, largely because of improved profits from its zinc and pyrite coproducts. Messina Transvaal Development Co. Ltd. decreased production at their mines in the northern Transvaal and drew on accumulated reserves in order to show a share dividend at yearend.

The Palabora Mining Co. Ltd's (PMC) open pit operation in the northeastern Transvaal reported a financially satisfactory year with sales of 104,231 tons of refined copper at an average c.i.f. price of $1,274 per ton ($0.58 per pound) and an average production cost of $1,090 per ton ($0.50 per pound). Byproduct magnetite, sulfuric acid,

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vermiculite, zirconium, uranium, and precious metals added more than $22 million to the company's gross sales. PMC was unable to achieve its targeted 30,000 tons of increased copper output. Installation of two large autogenous mills was completed in March 1977, but cracking of the revolving shells caused them to be stopped for extensive repair in mid-July for more than 2 months. Subsequent halts for inspection and additional repairs caused the loss of additional milling capacity and resulted in an estimated shortfall of 6,600 tons of copper during 1977. An additional loss of 5,000 to 6,000 tons of copper was predicted for late 1978-early 1979, when new shells are scheduled to be delivered and installed. Unusually heavy rains in February 1977 flooded the deeper (higher grade) part of the open pit for 36 days and were partly responsible for the lower average grade of ore during 1977. An oxygen plant was commissioned at PMC's smelter to increase the concentrate throughput and anode output. Concentrate purchased and smelted on toll from other producers accounted for 2,414 and 17,104 tons of anode copper, respectively. An extensive rectification program improved the deteriorating current efficiencies in the refinery during the latter part of the year. Domestic demand for copper wirebar and continuously cast rod was low during 1977, and most of PMC's production was exported as cathode.

Nearly 90 million tons of material, including almost 25 million tons of ore with 0.52% copper, was mined and hauled at PMC's open pit during 1977, more than 307,000 tons of concentrate containing 109,503 tons of copper was produced, and the smelter output of 126,037 tons of anode copper included 19,518 tons derived from concentrate purchased or treated on a toll basis. Refinery output increased 55% from 81,939 tons of cathode copper in 1976 to 126,681 tons in 1977, including nearly 20,000 tons refined as "toll."

The PMC operations are summarized in the following tabulation, in metric tons unless otherwise specified:

	1976	1977	Change (percent)
Ore and waste mined	79,287,000	89,480,000	+12.9
Ore milled	19,627,000	24,864,000	+26.7
Copper content of ore	107,950	129,292	+19.8
Concentrate produced	257,244	307,248	+19.4
Copper content of concentrate	94,450	109,503	+15.9
Anodes from PMC concentrate	93,360	106,519	+14.2
Anodes from concentrate purchased	2,304	2,414	+4.8
Anodes from toll concentrate	10,223	17,104	+67.3
Total anodes smelted	105,888	126,037	+19.0
PMC cathodes refined	71,501	106,698	+49.2
Other cathodes refined	10,438	19,983	+91.4
Total cathodes refined	81,939	126,681	+54.6
Precious metal in slimes	11.85	16.16	+36.4
Magnetite produced	563,808	449,789	-20.2
Vermiculite produced	222,079	165,420	-25.5
U_3O_8 in calcine	143.28	88.66	-38.1
Zirconia concentrate	7,490	8,715	+16.4
Zirconium chemicals	1,109	2,302	+107.6

Significant amounts of copper were recovered as byproducts of phosphate, platinum, and gold mining. On May 11, 1977, Phelps Dodge Corp. (PDC) announced an agreement with Gold Fields of South Africa Ltd. (GFSA) to develop the Aggeneys copper-lead-zinc deposit in northwestern Cape Province, previously held by the Black Mountain Mineral Development Co., a PDC subsidiary. In October the PDC holding was reduced to 49% with 51% held by GFSA. Cost of the mine and plant was estimated at $208.2 million for startup in 2 to 3 years to produce 1,125,000 tons of ore annually, with a recovery of some 22,000 tons of copper concentrate, 132,000 tons of lead concentrate, 35,000 tons of zinc concentrate, and 3.6 million ounces of silver. Copper reserves of this deposit are included in table 5, which shows ore reserves of the four major copper producers for 1977.

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Table 5.—Republic of South Africa: 1977 copper ore reserves

Deposit	Million metric tons	Copper (percent)
Aggeneys	200	0.45
Messina	4	1.38
O'okiep	27	1.67
Prieska	48	1.74
Palabora	526	.55
Total	805	.64

Gold.—Despite substantial increases in operating costs, the gold mines of the Republic of South Africa continued to produce nearly 60% of the world's gold. Although gold production declined 2% from 22.9 million troy ounces in 1976 to 22.5 million troy ounces in 1977, the reported value of gold produced increased 18% from $2,737 billion in 1976 to $3,237 billion in 1977. Gold mines of the Witwatersrand near Johannesburg produced 22,063,320 troy ounces (686,246.1 kilograms), mines in the Barberton district to the northeast accounted for 49,081 troy ounces (1526.6 kilograms), the Orange Free State tailings retreatment plant produced 10,365 troy ounces (322.4 kilograms), and 379,121 troy ounces (11,792 kilograms) came from small mines or was recovered as by-products from platinum, base metal, and phosphate ores. Production for 1976 and 1977 and proven reserves of major mines or companies are shown in table 6.

Table 6.—Republic of South Africa: Gold production

Producer	Production (troy ounces)		Developed ore[1]	
	1976	1977	Thousand metric tons	Troy ounce per metric ton
Barberton	38,578	49,081	NA	NA
Blyvooruitzicht	748,119	660,424	5,126	0.739
Bracken	239,098	182,124	1,100	.315
Buffelsfontein	945,518	925,478	6,441	.451
City Deep				
Consolidated Main Reef	93,816	11,118	NA	NA
Crown Mines				
Doornfontein	387,642	397,255	2,142	.437
Durban Deep	255,123	241,465	871	.264
East Daggafontein	69,809	--	--	--
East Driefontein	1,160,095	1,570,483	4,699	.906
East Rand Proprietary Mines Ltd.	354,639	320,913	1,374	.402
Freddies Consolidated	183,388	--	(2)	(2)
Free State Geduld	1,115,746	1,405,952	6,624	.666
Free State Saaiplaas	121,109	148,774	1,328	.228
Grootvlei	180,282	211,497	1,500	.163
Harmony	976,482	1,020,979	13,195	.289
Hartebeestfontein	1,035,794	1,022,583	11,439	.428
Kinross	353,761	373,862	4,100	.322
Kloof	538,486	654,428	3,438	.563
Leslie	174,424	131,850	1,000	.270
Libanon	330,789	449,339	2,181	.581
Loraine	253,878	256,209	2,845	.386
Marievale	113,827	110,701	200	.238
President Brand	1,183,626	996,123	7,114	.528
President Steyn	914,615	834,736	8,883	.452
Randfontein	514,315	561,030	3,034	.365
St. Helena	841,179	623,946	6,400	.775
South African Land and Exploration Co., Ltd	171,257	--	--	--
Stilfontein	528,188	527,336	3,222	.434
Vaal Reefs	2,122,090	2,061,689	15,263	.497
Venterspost	223,210	230,521	2,412	.287
Vlakfontein	107,429	68,417	NA	NA
Welkom	431,846	444,436	3,738	.418
West Driefontein	1,792,532	1,697,093	5,570	.863
West Rand Consolidated	167,743	136,094	525	.111
Western Areas	734,452	690,437	7,546	.276

See footnotes at end of table.

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Table 6.—Republic of South Africa: Gold production —Continued

Producer	Production (troy ounces)		Developed ore[1]	
	1976	1977	Thousand metric tons	Troy ounce per metric ton
Western Deep Levels	1,431,734	1,397,892	4,948	0.648
Western Holdings	1,204,164	1,144,669	7,181	.620
Winkelhaak	502,072	511,833	5,500	.357
Witwatersrand Nigel Ltd	44,252	41,632	237	.270
Major producer total or average[3]	22,585,109	22,112,403	151,176	.484
Anglo American OFS Joint Metallurgical Scheme	--	10,365	NA	NA
Others	350,909	379,118	NA	NA
Grand total all producers	22,936,018	22,501,886	--	--

NA Not available.
[1]Fully developed and blocked out only calculated at the Sept. 30, 1977 price of gold and at current operating costs. Additional indicated and inferred (possible) reserves are not included.
[2]Freddies Consolidated was sold to Free State Geduld Mines Limited during the fourth quarter, 1977. Production and reserve statistics are included in Free State Geduld reports.
[3]Data may not add to totals shown; however, they are as reported in "Source."

Source: Chamber of Mines of South Africa. Analysis of Working Results. October and December 1977.

Most of the mines produced their own bullion containing approximately 88% gold, 10% silver, and 2% base metals, in bars weighing between 800 and 870 troy ounces (25 to 27 kilograms, 55 to 60 pounds). The Rand Refinery at Germiston assayed and purchased the bars on behalf of the South African Government Reserve Bank, and payment was made to the producer within 5 days of the bars receipt, on the basis of the official gold price of $42.22 per troy ounce plus a premium to equal the world average monthly sales price. The refinery, with an annual capacity of 1,000 tons of gold and 100 tons of silver, produced 996 fine gold for coinage, 999 fine gold for industry and the arts, electrolytically refined silver, and platinum-group metals. The International Gold Corp. Ltd. (Intergold) arranged for gold sales to manufacturers, wholesalers, and retailers of gold products throughout the world. Sales of Krugerrand coins containing 1 troy ounce of gold increased about 10% over the 1976 sales to a total of 3,331,344 coins. About 1.5 million of these coins were sold during the final quarter of the year, when the International Monetary Fund auctioned nearly 1.6 million troy ounces of its gold reserve and the market price increased from $155 to $164 per troy ounce.

Several of the older Witwatersand gold mines ceased operations during 1977, but development work was accelerated at GFSA's Deelkraal mine and at the Anglo American Corp. Ltd. (AAC) Elandsrand mine, both near Carltonville, southwest of Johannesburg. Deelkraal's No. 2 shaft reached its final depth of 1,891 meters (6,145 feet) at the end of June, and a 113-meter section at its base was enlarged to accommodate underground headgear for a subvertical shaft from that location. The mine's uppermost ore horizon, with a gold content of 0.675 troy ounce per ton, was intersected at a depth of 1,857 meters. Deelkraal's estimated ore reserve was reported at 45 million metric tons at an average grade of 0.334 troy ounce per ton.

Elandsrand's main shaft was developing below the Ventersdorp contact reef at a depth of 1,921 meters (6,243 feet), and its second shaft cut the same reef at 2,044 meters (6,633 feet) in August. The capital cost of the operation was revised from $115 million to $159 million to commence production in 1979 instead of 1981 as originally scheduled. Ore reserves were estimated at 66 million tons, containing an average of 0.379 troy ounce of gold per ton. Surface installations and infrastructure were well advanced at both operations.

AAC's Joint Metallurgical Production Scheme to treat tailings (as well as certain concentrates) from six mines in the Welkom area of the Orange Free State Province, southwest of Johannesburg, commenced recovery of uranium in March and of pyrite in

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July, mostly from Free State Saaiplaas material. By yearend, recovery of 10,365 troy ounces of gold and 312.75 tons of U_3O_8 was reported. The East Rand Gold and Uranium Co. Ltd. (ERGO) plant, under construction by AAC to recover gold, uranium, pyrite (for sulfuric acid), and copper from 16 or more abandoned tailings and slimes dams east of Johannesburg, was scheduled to commence operations in 1978 after an investment of $161 million, and to produce about 225,000 troy ounces of gold, 200 tons of U_3O_8, and 530,000 tons of sulfuric acid annually for some 20 years.

Iron and Steel.—Domestic demand for iron and steel products declined as the production capacity of both Government and privately owned producers increased. Exports of iron ore and of ferroalloys increased substantially, but a general decline in construction activity was reflected in diminished local sales and imports of rolled and drawn products. ISCOR operated at about 80% of its rated capacity and produced 84% of the country's liquid and pig iron and more than 75% of its steel products, but reported a net loss of $56.5 million, the largest in 4 consecutive deficit years. South African Manganese Amcor Ltd.'s (SAMANCOR's) major share of ferroalloy production was cut to about 40% of the country's output as two new producers commenced exporting ferrochrome in 1977.

Iron Ore and Concentrate.—Hematite ore production, principally from the Sishen area, increased more than 75% from 12.2 million tons in 1976 to 21.4 million tons in 1977. Exports via the new Sishen-Saldanha railway and ore-loading installations at Saldanha Bay increased 200% in quantity and 248% in value, from 3.7 million tons worth $54 million in 1976 to 11.0 million tons worth $189 million in 1977. Domestic sales of hematite increased 11% in quantity and nearly 44% in value, from 8.5 million tons valued at $26.1 million in 1976 to 9.5 million tons worth $37.5 million in 1977. Although magnetite ore production increased 43% from 3.5 million to 5.0 million tons during 1977, exports of magnetite from Palabora decreased 20% from 550,000 to 440,000 tons, partly because of delays in transport to and loading at the Mozambique port of Maputo (formerly Lorenco Marques).

ISCOR has invested $1.2 billion in developing a new mine at Sishen in northern Cape Province, constructing 861 kilometers (535 miles) of heavy-duty, automated railroad with the capacity to transport 14 million tons of ore annually, and building a modern ore-loading port at Saldanha Bay 125 kilometers north of Capetown. The bay had an area of 52 square kilometers (20 square miles), was 30 meters deep in shipping lanes, and had a 3.6-kilometer (2.2-mile) causeway and loading jetty to accommodate four 150,000-deadweight-ton or two 350,000-deadweight-ton ore carriers simultaneously. Loaders were installed for one vessel at a rate of 8,000 tons per hour, but provision was made for additional loaders when required. Nearly 50 acres were prepared for stockpiling and reclaiming 2.4 million tons of different ore types or sizes, and provision was made for expansion to 10 million tons of stockpiles. On April 1, 1977, the rail line and port facilities were transferred to SAR&H. ISCOR was to receive a cash payment of $132.3 million and remained responsible for operating losses for 25 years. SAR&H was to assume ISCOR's capital commitment of $621 million.

Ferroalloys.—Highveld Steel and Vanadium Corp. Ltd. continued as the country's largest private producer of specialty steel and alloys, and reported a record net profit of $38.1 million out of a turnover of $166.2 million for its fiscal year ending June 30, 1977. Southern Cross Steel Co. (Pty.) Ltd. and Palmiet Chrome Corp. (Pty.) Ltd., both Barlow Rand subsidiaries, also reported profitable operations for 1977. Southern Cross was the country's only producer of stainless steel, and Palmiet discontinued production of low-carbon ferrochrome in favor of charge chrome and high-carbon ferrochrome. SAMANCOR operated 11 furnaces at its Metalloys subsidiary and 4 furnaces at its Ferrometals unit near Witbanks, Transvaal. Another 75-MVA furnace was planned for 1978 commissioning at the Metalloy plant in Meyerton at a cost of $46.0 million. SAMANCOR's 1977 production reportedly included 190,344 tons of ferromanganese, 78,010 tons of ferrochrome, and 43,686 tons of ferrosilicon. Consolidated Metallurgical Industries Ltd. (CMI), a subsidiary of Johannesburg Consolidated Investment Co. Ltd. (Johnnies), poured its first charge of ferrochrome in April 1977 and made its first shipment in October from the first of its three 40,000-ton-per-year furnaces at Leydesburg in the Transvaal. Tubatse Ferrochrome (Pty.) Ltd. commissioned the first of its three 40,000-ton-per-year (30-MVA) high-carbon ferro-

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chrome furnaces on May 18, 1977. The second unit was operational by yearend, and the third was scheduled to be run-in during 1978. General Mining and Finance Corp. Ltd. owned 51% of Tubatse with Union Carbide as minority partner and manager of the modern, low-cost, pollution-free plant to produce charge chrome for export using ore from General Mining's Groothoek and Hendriksplaats chromite mines, 16 kilometers from Lydenburg.

Although there was no direct U.S. involvement in South Africa's steel industry, Foote Mineral Co., a Newmont subsidiary, had an interest in Silcon Smelters (Pty.) Ltd. of Pietersburg, Transvaal; Union Carbide was involved at Tubatse (see above), and in vanadium with UCAR South Africa, at Brits, Transvaal; and Koppers is interested in "black" products from ISCOR's coke ovens. Reported production of ferroalloys in metric tons is shown in the following tabulation:

	1976	1977
Ferrochrome	238,520	226,179
Ferromanganese	469,060	444,457
Ferrosilicon	115,220	109,164
Ferrovanadium	300	300
Total	823,100	780,100

Manganese.—The Republic of South Africa remained the world's second largest producer of manganese (after the U.S.S.R.) and the free world's largest exporter. Total manganese production declined nearly 4% from 5.5 million tons in 1976 to 5.0 million tons in 1977 because diminished demand for metallurgical grades of ore resulted in curtailment of mine production in the second half of the year. Increases of 25% in the cost of electrical power and 20% in railroad freight rates for export ore came into effect during 1977. Export and domestic sales of metallurgical-grade ores decreased slightly in both quantity and value. Virtually all export ore continued to be transported 800 kilometers by rail for dispatch from Port Elizabeth, where stockpiling and loading facilities formerly used for iron ores were underutilized after the Sishen-Saldanha railroad was commissioned in 1976. Most of the major manganese mines in the 65-square-kilometer Postmasburg field were associated with the hematite ores of the Sishen-Postmasburg area and its northern extension, the Kuruman or Kalahari field, where generally higher-grade ores have been found along a strike length of about 60 kilometers extending towards the Botswana border. In both fields the manganese ore occurred in one or more gently folded or dipping beds ranging from 6 to 30 meters in thickness. The ore generally contained a maximum of 0.05% phosphorus and 0.03% sulfur. At SAMANCOR's large Wessels underground mine, production capacity was increased from 300,000 to 500,000 tons per year by commissioning a second inclined shaft and by improvements to the crushing and sizing plant. Shaft sinking started in February 1977 at AAC's new Middelplaats underground mine, downdip and west of the Mamatwan open pit. Production of approximately 1 million tons per year of plus 38% manganese ore was scheduled for 1979.

The purchase of the Gopane mine in Bophuthatswana near Zeerust, Transvaal, by the Rand London Manganese Mines (Pty.) Ltd. was confirmed in July 1977, and the new owners opened the recently completed Mangope shaft. The Gopane mine, previously owned by General Mining's Marble Lime and Associated Industries Ltd., was an underground producer of battery-grade (plus 65% MnO_2) ore and held a long-term contract to supply uranium-grade (plus 40% MnO_2) ore to the Rossing uranium mine in Namibia, owned by Rio Tinto Zinc Corp. Ltd. and others.

The South African Geological Survey revised its estimates of manganese resources to 300 million tons at more then 40% Mn, 2,000 million tons between 30% and 40% Mn, and 5,000 million tons between 20% and 30% Mn.

Nickel.—Electrolytically refined nickel was a byproduct of the country's platinum-group metals, and production increased about 2.5% to a record 21,955 tons in 1977. Most of the production was exported to captive buyers in Norway, Canada, the United Kingdom, and the United States. Export values increased by about 10.9% for some 19,694 tons of metal, but the value of domestic consumption (mostly by the stainless steel industry) declined 5.7% compared with that of 1976.

Platinum.—Although published figures were not available, it was estimated that production of platinum-group metals increased about 6.3% to 2,870,000 troy ounces in 1977 from 2,700,470 troy ounces in 1976, accounting for nearly 50% of world production. Because of the high platinum-

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palladium ratio of its ores, the country's production of platinum metal at 1,809,000 troy ounces was the world's highest. Virtually all of the production came from four companies operating on the Merensky Reef in the Transvaal's renouned Bushveld Igenous Complex. Ore production increased from 14.2 million tons in 1976 to 15.1 million tons in 1977. On October 19, 1977, the Atok Platinum Mines (Pty.) Ltd., owned by Anglovaal, U.S. Steel Corp., and others, was taken over by the Rustenburg Platinum Mining Co. Ltd. in return for 1.9 million Rustenburg shares worth approximately $2.5 million. The Atok property was within the Lebowan Homeland; the Impala Platinum Mines (Pty.) Ltd. and part of the Rustenberg properties were within the boundaries of the new Bophuthatswana Homeland, which became independent on December 6, 1977.

A small part of the country's platinum-group metal production was recovered from Palabora Copper Mines tankhouse slimes, and the Witwatersrand gold mines continued to produce some 6,000 troy ounces of osmium and iridium, the hardest and heaviest of the platinum-group metals.

Tin.—Evidence of ancient tin smelting was discovered in the Cape Province in the late 1800's, and a number of ancient tin workings in the Transvaal Province have been examined since the discovery of the Rooiberg tinfields in 1905. A comparison of production from the three modern tin mining companies for 1976 and 1977 follows, in metric tons:

Company	1976		1977	
	Ore	Concentrate	Ore	Concentrate
Rooiberg Minerals Development Co. Ltd	132,451	3,739	135,437	4,563
Union Tin Mines Ltd	33,876	1,628	34,333	1,268
Zaaiplaats Tin Mining Co. Ltd	74,006	258	73,500	308
Total	240,333	5,625	243,270	6,139

Union Tin Mines Ltd. of GFSA continued, but did not complete cleanup operations during 1977. The delay in phasing out the operation, scheduled because of declining ore grade, was probably due to increased tin prices. Rooiberg's production increased and the company commenced construction of a 2,000-ton-per-year tin smelter near its "A" concentrator on the Olievenbosh property. The capital cost was reported at about $2.1 million and the startup was scheduled before the end of 1979.

Zaaiplaats continued to operate the country's only tin smelter and reported the production of 582 tons from its own ore and custom smelting during 1977. Zaaiplaats' production was all consumed by local industry, and some 1,239 tons of tin metal was imported, an increase of 34% over the 928 tons reported for 1976.

Uranium.—Uranium production in the Republic of South Africa continued, largely as a byproduct of the gold-mining industry. Production of U_3O_8 increased 21.7% from nearly 3,255 tons in 1976 to 3,962 tons in 1977, with estimated increases in export quantity and value of 29% and 49%, respectively, from 2,604 tons worth $70.3 million in 1976 to 3,368 tons valued at $104.4 million in 1977. Table 7 shows the 1976 and 1977 production of U_3O_8.

Table 7.—Republic of South Africa: Production of U_3O_8

(Kilograms)

Company or mine	1976	1977
Blyvooruitzicht	131,064	199,949
Buffelsfontein	606,800	653,200
Harmony	497,208	535,820
Free State Saaiplaas	0	45,545
Hartebeestfontein	348,632	377,405
Randfontein	0	3,635

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Table 7.—Republic of South Africa: Production of U_3O_8 —Continued

(Kilograms)

Company or mine	1976	1977
Vaal Reefs	1,012,997	1,016,955
West Driefontein	227,186	295,567
Western Deep Levels	140,001	167,410
West Rand Consolidated	147,478	265,559
Anglo American OFS Joint Metallurgical Scheme	0	312,750
Palabora Copper	143,277	88,661
Total	3,254,643	3,962,456

Although AAC's Joint Metallurgical Treatment Scheme officially started in the Orange Free State Province on August 3, 1976, and uranium recovery did not commence until March 1977, the uranium produced accounted for 44% of the increase in total uranium production during the year. AAC's ERGO project to treat abandoned slimes and tailings from Transvaal mines east of Johannesburg was scheduled to be in full production in 1978 and to produce 200 tons of uranium per year.

Except for Palabora, all uranium production was sold through the Nuclear Fuels Corp. (NUFCOR), a consortium of major South African companies, and marketed by the Chamber of Mines of South Africa. In July 1977, NUFCOR reportedly negotiated a contract for the Compagnie Generale des Matières Nucleaires (a subsidiary of the French Atomic Energy Authority) to buy 900 tons of U_3O_8 worth $52.9 million annually from Randfontein Estates for a 10-year period starting in 1980. The sliding-scale price was initially pegged at $26.80 per pound of U_3O_8. An interest-free loan of $103.5 million supported by the French Atomic Energy Authority was to finance refurbishing of Randfontein's Cooke plant at Millsite near Johannesburg. Engineering services were to be under the joint management of Johannesburg Consolidated Investment Co. Ltd. (Johnnies) and the Bechtel Corp. of the United States.

In May 1977, the Government's Uranium Enrichment Corporation (UCOR) announced that its Helikon enrichment process had proved sucessful in pilot plant operation, and that it was ready to discuss enrichment service contracts for 1986-87. UCOR's full-scale production plant was targeted for the production of 5,000 tons per year of enriched uranium fuel using uranium hexafluoride as feedstock and an aerodynamic process similar to the West German jet-nozzle development. The cost was estimated at $1.4 billion, and the percentage of the more highly fissionable uranium-235 isotope would be increased from its natural 0.7% to 3.5% of its predominantly uranium-238 content. A "profitable" selling price of $74 per kilogram of enriched product was reportedly about 25% lower than prices discussed elsewhere in the world for mid-1980's enrichment contracts.

In November 1977, Dr. Ampie Roxu, President of South Africa's Atomic Energy Board, predicted that uranium mines with gold as a byproduct would be developed on the Witwatersrand deposit in the Orange Free State. Three major companies were known to be drilling in this area. Union Corp. Ltd. located sufficient uranium near the Harmony mine to support at least one full-scale operation, with ore containing about 0.25 kilogram of U_3O_8 and 0.161 troy ounce of gold per ton. AAC was drilling on an adjoining property and at another site near Welkom, and GFSA was reportedly drilling near Union. Exploration also continued in the Karroo Basin of Central Cape Province.

Vanadium.—The Republic of South Africa continued to be the world's largest producer of vanadium and the source of more than half the free world's supply. Economically recoverable vanadium reserves were considered to be the largest known and were revised by the country's Geological Survey to a total of 232 million tons of ore containing 1.5% to 2.0% V_2O_5 to a depth of less than 100 feet in the magnetite ores of the Bushveld Igneous Complex. Production in 1977 increased 14% to 20,061 tons of V_2O_5, compared with 17,628 tons in 1976. Exports increased 6% in value from R49.7 million to R52.6 million during the same period, while local sales tripled in quantity and value. Highveld Steel and Vanadium Corp. Ltd., the country's (and the world's)

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leading vanadium producer, curtailed production at its 12,000-ton-per-year plant during the last half of the year and was reportedly operating at only 70% of capacity in December 1977. Ucar Minerals Corp. Ltd. of Union Carbide, S.A. Ltd., operated its plants at Brits and Bon Accord, near Pretoria, at full capacity during 1977 but indicated that production would be cut in 1978. The Otavi Mining Co. Ltd. mine, operated by Transvaal Alloys (Pty.) Ltd., and its 1,500-ton-per-year plant at Wapadskloof, 100 kilometers northeast of Middleburg in northern Transvaal Province, were reportedly expected to expand operations if export sales to West Germany and to the Taiyo Koko company of Japan continued to improve.

Zinc.—Anglovaal's Prieska Copper Mines (Pty.) Ltd. (PCM), at Copperton, 65 kilometers southwest of Prieska, continued to be the country's only zinc producer in 1977. Prieska's concentrate production declined 7.1%, from 149,922 tons at 52.4% zinc in 1976 to 139.262 tons at 51.3% zinc in 1977. Export sales under contract to Metallgesellschaft in West Germany declined 30.8% in quantity and 37.6% in value. Increases of 36.8% in quantity and 24.5% in value were reported in domestic sales to GFSA's Zinc Corp. of South Africa Ltd. (ZINCOR), which reported a 14.6% increase in production of electrolytically refined zinc to a record 75,965 tons in 1977, partly from concentrate imported from Canada. On May 11, 1977, PDC announced agreement with GFSA for the development of the Aggeneys copper-lead-zinc deposit in northwestern Cape Province, previously held by PDC's subsidiary Black Mountain Mineral Development Co. Ltd. Ore reserve at the Aggeneys deposit was estimated at 38 million tons containing 0.45% copper, 6.25% lead, 2.87% zinc, and 0.08% silver in proved ore, with 162 million tons of probable ore at similar grades. In October it was announced that GFSA would manage and hold 51% of the operation, and PDC's holding was reduced to 49%. More than $208 million was to be invested in the mine and plant with a capacity to produce 1,125,000 tons of ore and to recover 20,000 tons of copper concentrate, 132,000 tons of lead concentrate, 35,000 tons of zinc concentrate, and 2.6 million ounces of silver annually. Production was to start in 2 to 3 years. Newmont Mining Corp. and AAC anounced that development of their lead-zinc deposit at Gamsberg near Springbok in Cape Province was to be postponed. The capital cost was estimated at $195.5 million.

NONMETALS

Asbestos.—The Republic of South Africa was a major producer and exporter of three different types of asbestos and was virtually the only source for the crocidolite and amosite varieties. Most of the U.S. consumption was chrysotile asbestos imported from Canada. Overall production of asbestos in the Republic increased by 2.8%, while exports rose 5.3% in quantity and 19% in value. Cape Blue crocidolite production increased 12.7% from 178,411 tons in 1976 to 201,056 tons in 1977, while amosite production declined 15% from 78,898 tons to 66,983 tons, mostly during the last 6 months of 1977. Chrysotile asbestos becomes brittle at about 650° C (1,200° F) but is readily decomposed by acid, tends to pack when wet or shaken, and is generally inferior to the other varieties for certain uses. Crocidolite asbestos from the Cape Province has a high percentage of long fibers of high tensile strength. It is acid resistant, but the fibers become brittle at about 360° C (680° F). Amosite is similar to crocidolite in tensile strength and spinnability and becomes brittle at a higher temperature. It is unsurpassed in fiber length, is resistant to both acids and seawater, and does not pack under vibration or after wetting. It is particularly useful as an insulating covering for marine turbines and jet engines and in similar applications. The health hazards of asbestos fibers prompted a study of the world's asbestos industry by the Minerals Bureau of the South African Department of Mines early in 1977, and an international symposium on the subject, convened by the National Research Institute for Occupational Disease in Johannesburg, October 3-7, 1977, was attended by delegates from 11 countries including the United States. Officials of the domestic asbestos mining industry have cooperated with the Department of Mines in negotiations following the recommendations of the symposium. Dust control and sophisticated monitoring techniques were being incorporated in equipment for the Pomfret asbestos mine and newly designed mill in northern Cape Province. Installation of equipment for mechanical underground mining and construction of a mill to produce 70,000 tons of bagged asbestos fiber per year was started at Cape Asbestos S.A. (Pty.) Ltd.'s (CASA) Cape Blue mine and

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mill at Pomfret, in northern Cape Province, 200 kilometers north of Kuruman. Cape Asbestos was registered in South Africa in 1893 after incorporation in London, to acquire properties of the Cape Mineral Syndicate which was developing asbestos deposits discovered 90 years earlier in the Orange River Valley. The Pomfret deposit was discovered in 1927 and mined from outcrop until 1937 when the first inclined shaft was sunk. The deposit has been the source of high-quality, long-spinning fiber exported worldwide. Cape Asbestos also operated the 90,000-ton-per-year amosite plant at Penga in the northeastern Transvaal.

Cement and Limestone.—Despite construction of infrastructure for the SASOL II project, construction generally declined throughout the country. The decline was reflected in diminished quarrying of limestone and shale (although burnt lime production increased) and in decreased production of cement.

Diamond.—Overall production of diamond (gem and industrial) increased 8.8% from 7.0 million carats in 1976 to 7.6 million carats in 1977. Sales of diamonds decreased 1.1% in quantity, but increased 19.8% in value from $247.4 million for 7.6 million carats in 1976 to $296.2 million for 7.5 million carats in 1977, reflecting world market price increases of 15% and 17% announced by De Beers' Central Selling Organization in March and December, respectively. Table 8 shows the marketed output of diamonds in carats and the U.S. dollar equivalents of the average prices per carat realized for diamonds from various sources in the Republic of South Africa. Virtually all production from the Transvaal Province was from the Premier mine near Pretoria, formerly 60% State-owned, but operated and 40% owned by Premier (Transvaal) Diamond Mining Co. (Pty.) Ltd. (PDMC), a wholly-owned subsidiary of De Beers. As of January 1, 1977, the parent company arranged to lease directly the 60% Government share and to pay $1.15 million to PDMC for its 40% share and to provide for additional capital for development to extract diamondiferous kimberlite from below the massive 100-meter sill of barren gabbroic rock cutting through the Premier pipe at a depth of nearly 500 meters. In return for committing capital to develop what amounts to a new, deep, diamond mine, De Beers was allowed a reduced lease-consideration rate from Government, a lower income tax rate, and an exemption from paying export duty on the portion of production destined for overseas sales. The price terms of the agreement were to be approved by the Minister of Mines early in 1978. Premier diamond production in 1977 included 333,000 carats from re-treating old dump material containing 0.1912-carat-per-ton, and 1,677,000 carats from underground ore and stockpiled ore containing 0.3145-carat-per-ton. Design work for mining below the gabbro sill was completed, and development work had provided access to the first reserve block selected for initial mining below the sill. This block was estimated to contain 14 million tons of kimberlite with an average diamond content of 0.72-carat-per-ton.

In the Cape Province, De Beers' largest producer was the Finch kimberlite pipe, west of Kimberly, which produced 2,426,000 carats from ore containing 0.6665-carat-per-ton. The Wesselton and Bultsfontein pipes produced 529,000 and 330,000 carats from ore containing 0.27- and 0.32-carat-per-ton, respectively, and the De Beers and Dutoitspan pipes produced 114,000 and 112,000 carats from ore containing about 0.16-carat-per-ton. De Beers also operated the Annex Kleinzee and Dreyers Pan mines in northwest Cape Province (Namaqualand) where ancient marine terrace gravels yielded 604,000 and 558,000 carats of alluvial diamonds from gravels containing averages of 0.23- and 0.39-carat-per-ton at an average size of 0.76- and 0.58-carat, respectively. The proportion of gem to industrial stones was much higher in alluvial deposits than in the kimberlite material.

In addition to De Beers output, The Nababeep Minerals Exploration Co. (Pty.) Ltd. produced some 200,000 carats of alluvial diamonds from its alluvial mine at Sendelings drift near the Orange River, northwest of O'okiep in northern Cape Province, and the State Alluvial Diggings also produced nearly 200,000 carats of alluvial stones from Nababeep's self-sustaining operation near Alexander Bay.

DeBeers' Koffiefontein mine, a kimberlite deposit 80 kilometers southeast of Kimberly, was responsible for virtually all of the diamond production from the Orange Free State Province. It accounted for nearly 410,000 carats of diamonds from 3.7 million tons of kimberlite containing an average of 0.11 carat per ton.

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Table 8.—Republic of South Africa: Marketed diamond output, by province

Province	1976		1977	
	Output (carats)	Price per carat	Output (carats)	Price per carat
Mine diamond:				
Transvaal	2,083,709	$11.55	2,033,790	$12.90
Cape Province	3,642,727	22.95	3,627,912	25.22
Orange Free State	408,942	52.83	455,780	84.37
Total	6,135,378	21.07	6,117,482	25.53
Alluvial diamond:				
Transvaal	10,784	104.16	10,014	154.85
Cape Province	1,404,959	83.22	1,338,906	103.42
Orange Free State	61	207.38	34	434.29
Total	1,415,804	83.38	1,348,954	103.81
Grand total	7,551,182	32.75	7,466,436	34.50

Fluorspar.—The overall production of fluorspar increased 20.6% to a new high of 350,679 tons in 1977 compared with 290,718 tons in 1976. The greatest increase, 66%, was for ceramic grades, while output of metallurgical and acid grades increased by 24.8% and 11.3%, respectively. The value of local sales and exports increased 3.3% and 16.2%, respectively, in 1977, chiefly because of increased prices for metallurgical grades in both domestic and world markets. The country's proven fluorite ore reserves were recalculated as shown in table 9.

Table 9.—Republic of South Africa: Fluorite ore reserves

Location and type	Million tons	CaF_2 (percent)
Western Transvaal dolomitic ore	60	15-30
Bushveld granitic ore	40	25
Rust de Winter hematitic ore	18	+30
Total	118	XX

XX Not applicable.

Phosphate.—The Government-controlled Phosphate Development Corp. Ltd. (FOSKOR) continued as the major producer of phosphate rock from its open pit mine in the apatite-rich ring of the Palabora carbonatite structure in northeastern Transvaal. Overall phosphate ore production increased 24% to a new high of 14.6 million tons in 1977 over the 1976 record of 11.8 million tons. Domestic sales of crude ore decreased 43% in quantity and 24% in value. FOSKOR was responsible for nearly 90% of the 2.25 million tons of concentrate sold locally, of which more than 430,000 tons were sold to Federale Kunsmis Ltd. (FEDMIS) and Triomf Fertilizers (Pty.) Ltd. for the manufacture of phosphoric acid for export. Triomf operated its newly commissioned phosphoric acid plant at Richards Bay throughout 1977. The plant was designed to convert domestic and imported pyrite into 1.1 million tons of sulfuric acid per year. The acid will be used to treat 1.2 million tons of phosphate rock and produce 375,000 tons of 52% to 56% phosphoric acid annually. The phosphoric acid was pumped directly from the plant's storage tanks to the dockside for easy loading. No phosphate ore was exported, and concentrate export declined from 11,118 to 4,510 tons during the year. SAMANCOR reported sales of about 200,000 tons of concentrate from its Langebaan mine in Cape Province, and GFSA's Glendover Phosphate Ltd. of Thabazimbi in northwest Transvaal Province sold nearly 100,000 tons of selective mine-run and handcobbed ore during 1977.

About 40% of FOSKOR's mill feed consisted of phosphate-rich tailings pumped from the neighboring Palabora copper con-

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centrator. Copper concentrates recovered from FOSKOR ores were smelted and refined in the Palabora facilities. FOSKOR's iron ore and zirconium byproducts continued to be marketed by a subsidiary company.

MINERAL FUELS

Coal.—Following the commissioning of the new Richards Bay coal-loading facility in April 1976 and the startup of new mines, overall coal production increased by 9 million tons and total exports by nearly 7 million tons to highs of 11.7% and 113%, respectively, greater than the 1976 records. The overall sales value (local sales plus exports) increased 46% from $595 million in 1976 to $869 million in 1977. Exports were expected to increase from 12.7 million tons recorded in 1977 to the 20-million-ton-per-year targeted capacity of Richards Bay by 1980-81. Domestic sales of anthracite declined by nearly 13% from 773,279 tons in 1976 to 673,583 tons in 1977, but the value increased from $12.8 million in 1976 to $13.2 million in 1977.

Coal imports were reduced to less than 300,000 tons, of which nearly 60,000 tons came from the United States and the remainder from undesignated, probably neighboring Southern African, sources. About 55% of the 73 million tons of domestically consumed coal was for the production of electricity, and 13% was used for the production of coke, chiefly for metallurgical industries, which also consumed part of the 11% used by "industries." The SASOL I oil-from-coal project accounted for 7% of the domestic consumption; household use, 4%; production of coal gas, 3%; and consumption at coal mines, use by other gas producers, and transport, 2% each; 1% was used in other mining operations. Details of production and sales of coal are shown in table 10.

Table 10.—Republic of South Africa: Coal production, local sales, and exports

	1976		1977	
	Quantity (thousand metric tons)	Value (thousand dollars)	Quantity (thousand metric tons)	Value (thousand dollars)
Bituminous and subbituminous:				
Production	74,600	NA	82,852	NA
Local sales	68,987	463,658	71,649	569,676
Exports	4,431	84,546	10,478	229,143
Anthracite:				
Production	2,459	NA	2,559	NA
Local sales	773	12,844	674	13,207
Exports	1,530	34,995	2,224	56,691

NA Not available.

Anglo American's Amcoal subsidiary reported that surface and underground work was on schedule at its Kleinkopje Colliery adjacent to its Landau No. 3 Colliery, near Witbank, Transvaal Province. Kleinkopje's opencast-underground operation was scheduled to achieve initial production of 2.7 million tons per year by 1979 at a capital cost of $125 million. Amcoal's new $127.7 million Kriel colliery reached its initial production level of 304,000 tons per month in August 1977, and its highly automated combined opencast-underground operation was expected to have a production rate of 6.5 million tons per year by mid-1979. The Republic's newest steam coal producer, the Ermelo Mines, jointly owned by General Mining and Finance Corp. Ltd., Union Corp., Ltd., British Petroleum, and Total Oil, expended nearly $75 million on its highly automated underground installation, which is scheduled to produce 3 million tons per year of steam coal for export by mid-1979. Initial production was reported during the third quarter of 1977. Construction and development of an open pit mine with a washing and sizing plant at the nearby Reitspriuit Colliery were also reportedly on schedule. An investment estimated at $115 million by Shell Coal of South Africa Ltd. and Transvaal Consolidated Land and Exploration Co. Ltd. (TCL) provided for initial production at 3 million tons per year in 1979 and 5 million tons per year at a later date under the management of Rand Mines Ltd. In April 1977, Duiker Exploration Ltd. of Lonrho South Africa Ltd. commenced expending $39 million for shaft sinking

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at its recently acquired Tweefontein's Boschmansfontein property near Witbank. Three seams of coal were expected to yield 2 million tons of steam coal per year for domestic consumption by 1980.

SASOL continued operation of its Sigma Colliery and the adjacent SASOL I oil-from-coal plant in Orange Free State Province. Its subsidiary SASOL (Transvaal) Ltd. (SASOL II) completed development of its Bosjesspruit mine and much of its housing facilities at Secunda during the year. Most of the design engineering was completed, and major contracts and orders had been placed. Fluor Corp. of Los Angeles was the prime contractor for the chemical complex, and of the $2.9 billion (up from the previous $2.2 billion) estimated costs, $1.56 billion was scheduled to be spent in the Republic. Reportedly, 228 contracts worth $964 million had been placed with local firms.

An economically viable low-sulfur coal deposit of 300 million tons was reportedly proved by BP in the Middleburg area of the Transvaal. Government investigation of widespread deposits with recoverable coking-grade coal was continuing in the northern Transvaal, from near Ellisras in the west into the Kruger National Park towards the Mozambique border.

Petroleum.—Imports of crude petroleum for the domestic refineries decreased. On December 12, 1977, the Minister of Mines acknowledged a second strike of natural gas in a well drilled by the Sedco K offshore rig drilling for the Southern Oil Exploration Corp. (Pty.) Ltd. (SOEKOR). It was reported that the results were more encouraging than those encountered in the December 17, 1976 strike in the same general area, 61 kilometers south of the southern coast and about equidistant from Mossel Bay and Plattenburg Bay. High-pressure gas and condensate encountered at a depth of 2,987 meters (9,800 feet) was comparable to results of a 1969 strike made in the same area by Superior Oil Co., which subsequently relinquished its offshore lease.

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[1]Physical scientist, Branch of Foreign Data.

[2]Regional Resources Officer, U.S. Consulate General, Johannesburg, Republic of South Africa.

[3]Where necessary, values have been converted from South African rands (R) to U.S. dollars at the rate of R1=US$1.15 as shown in International Financial Statistics, v. 31, No. 10, 1977, p. 329.

[4]South African Mining and Engineering Journal. December 1978, p. 7.

[5]Gossling, H.H. An Updated Summary of the World's Fluorspar Industry, 1975. National Institute for Metallurgy, (Johannesburg): Rept. 1814, Mar. 9, 1976.

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The Mineral Industry of the Territory of South-West Africa

By Candice Stevens[1]

The mineral industry of the Territory of South-West Africa contributed approximately 46% to the 1977 gross domestic product (GDP) estimated at $1 billion.[2] Diamond ($220 million) and uranium ($175 million) were the major minerals in terms of value. Two firms, Consolidated Diamond Mines of South-West Africa (Pty.) Ltd. (CDM) and Rössing Uranium Ltd., accounted for 85% of the value of mineral output. The contribution of base metals fell to under 15% of mineral income in 1977 from 40% in 1976, owing to low metal prices. Tsumeb Corp. Ltd. and other base metal producers suffered losses during the year. Tsumeb kept two of its mines inactive in 1977, and Otjihase Mining Co. (Pty.) Ltd.'s copper mine was closed at yearend.

Construction ceased on the Ruacana Falls hydroelectric scheme owing to a dispute between Angolan and South African authorities. The project, involving the construction of a series of dams and hydroelectric plants along the Cunene River on the Angolan border, was financed largely by the Republic of South Africa. As originally conceived, the Ruacana Falls scheme would have supplied power to Windhoek, Swakopmund, Walvis Bay, and the Tsumeb operations. In 1977, the Republic of South Africa undertook to build a 120-megawatt powerline linking the Territory of South-West Africa with the Electricity Supply Commission of South Africa (ESCOM) grid.

PRODUCTION AND TRADE

The compilation of separate production and trade statistics for the Territory of South-West Africa was suspended by the South-West Africa Administration in 1965. Most of the statistical data on production of mineral commodities listed in table 1 were derived from the annual reports of the companies operating in the Territory. Trade statistics are incorporated with those of the Republic of South Africa, with which the Territory is a member in the South African Customs Union.

The country's primary mineral commodities in terms of revenue, diamond and uranium, showed substantial production increases in 1977. Copper production at the major mines of Tsumeb and Oamites Mining Co. (Pty.) Ltd. increased, but lead and zinc mine production evidenced a decline. Tin, tungsten, and vanadium production increased over 1976 levels.

The Territory's balance-of-trade surplus was estimated at $300 million in 1977. Steadily rising earnings from uranium and diamond were expected to keep the trade balance in surplus despite reduced revenue from base metal exports. Minerals accounted for approximately 60% of the total export value. Diamond was marketed by De Beers Consolidated Mines Ltd. The Republic of South Africa was the Territory's largest trading partner, taking about 50% of exports and supplying an estimated 80% of imports.

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Table 1.—Territory of South-West Africa: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS[2]			
Arsenic, white[3]	6,663	5,122	2,615
Cadmium:			
Mine output, metal content, recoverable	r118	118	88
Metal, refined	102	83	80
Copper:			
Mine output, metal content, recoverable[4]	39,034	36,000	36,234
Metal, blister	36,410	36,100	53,400
Lead:			
Mine output, metal content, recoverable	r53,100	46,400	41,200
Metal, refined	44,300	39,600	42,700
Silver:			
Mine output, metal content, recoverable[5] thousand troy ounces	1,823	r1,400	1,684
Smelter output, content of blister copper do	2,077	e1,250	1,200
Tin, mine output, metal content, recoverable	760	800	994
Tungsten, mine output, metal content, recoverable[e]	160	140	150
Uranium, U_3O_8 content	NA	700	2,760
Vanadium, mine output, metal content[e]	562	700	750
Zinc, mine output, metal content[6]	43,251	41,308	38,300
NONMETALS			
Diamond:[7]			
Gem[e] thousand carats	1,660	1,609	1,901
Industrial[e] do	88	85	100
Total do	1,748	1,694	2,001
Lithium minerals[8]	51,573	5,915	2,548
Pyrite concentrates, gross weight	9,643	9,200	9,000
Salt[e]	210,000	220,000	230,000
Sulfur, content of pyrite	4,455	4,000	4,000

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, the Territory of South-West Africa, prior to 1967, produced bismuth concentrate, cesium ore, columbite-tantalite concentrate, gold, manganese ore, molybdenum concentrate, graphite, kyanite, lime, mica, precious stones, sillimanite, and a variety of crude construction materials (clays, stone, and sand and gravel). No official statistics have been published since yearend 1966, and available information is inadequate to ascertain whether production has been continued or not, and if so, at what levels.

[2]Data are compiled from operating company reports as follows: Tsumeb Corp. Ltd. (arsenic, mine and refined cadmium, mine and blister copper, mine and refined lead, mine and smelter silver, mine zinc, and pyrite concentrate); South West Africa Co. Ltd. (SWACO) (mine lead, mine tin, mine tungsten, mine vanadium, and mine zinc); South African Iron and Steel Industrial Corp. Ltd. (ISCOR) for Imcor Zinc (Pty.) Ltd.'s Rosh Pinah mine (mine lead and mine zinc) and for ISCOR's own Uis mine (mine tin); General Mining and Finance Corp. Ltd. for Klein Aub Koper Maatskappy Ltd.'s mine near Rehoboth (mine copper and mine silver); and Falconbridge Nickel Mines Ltd. for Oamites Mining Co. (Pty.) Ltd.'s Oamites mine (mine copper). Data from Tsumeb and Falconbridge are for calendar years; data from other companies are for fiscal years ending June 30 of the year stated.

[3]White arsenic equivalent of all arsenic products reported as being produced.

[4]Figures comprise reported production of Tsumeb and Oamites plus estimates for Klein Aub and Johannesburg Consolidated Investment Co. Ltd.'s (JCI) Otjihase copper mine.

[5]Figures comprise reported production of Tsumeb plus estimates for Oamites and Klein Aub.

[6]Figures comprise reported production of ISCOR for Imcor's Rosh Pinah mine plus estimates for Tsumeb (based on ore milled) and SWACO.

[7]Totals are reported by De Beers Consolidated Mines Ltd. in company annual reports (for calendar years). Detail on gem and industrial diamond are estimates, assuming output to be 95% gem quality.

[8]Output has not been officially reported since 1966 but presumably has continued, since a number of countries record imports from "South Africa," which in total quantity considerably exceed the reported output of the Republic of South Africa and thus presumably include imports from the Territory of South-West Africa. Quantities given represent imports of the United States and the European Communities reported as originating in the Republic of South Africa, but a portion of the material may have been mined in Southern Rhodesia.

COMMODITY REVIEW

METALS

Tsumeb was the Territory's principal producer of nonferrous metals, including copper, lead, zinc, silver, cadmium, and arsenic. The value of its metal sales increased from $52 million in 1976 to $61 million in 1977. Newmont Mining Corp. (United States) was the manager and a principal shareholder (29.2%) of Tsumeb, whose other owners included AMAX, Inc. (29.2%), Selection Trust Ltd. (14.2%), O'okiep Copper Co. Ltd. (9.5%), Union Corp. Ltd. (9.4%), South West Africa Co. Ltd. (SWACO) (2.4%), and others (6.1%).

The company's largest mine, Tsumeb, milled 490,000 tons of ore containing 4.7% copper, 7.8% lead, and 2.0% zinc in 1977. The lower grade in 1977 was symptomatic of the gradual decrease in lead content as progressively deeper ore was mined. Reserves at Tsumeb, located 400 kilometers

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north of Windhoek, were estimated at 4.9 million tons containing 4.4% copper, 7.1% lead, and 1.9% zinc.

Approximately 122,000 tons of ore containing 2.2% copper was milled at the Matchless mine, located 42 kilometers south of Windhoek. Reserves were estimated at 996,000 tons of ore containing 2.3% copper. Tsumeb halted development work at the Matchless mine during 1977 as part of an overall cost-reduction program.

The Kombat and Asis Ost mines, located near the Tsumeb mine, were inactive in 1977. Development work continued at the Asis West mine, where reserves were estimated at 1.5 million tons grading 7.8% copper and 4.3% lead. Production at Asis West, under the joint ownership of Tsumeb (85%) and SWACO (15%), was scheduled to begin in 1979.

Tsumeb produced 22,827 tons of copper and 34,446 tons of lead in 1977. A total of 1,141 tons of zinc metal contained in concentrates was exported from Walvis Bay for overseas smelting and refining. Tsumeb also produced 2,615 tons of arsenic trioxide material, 88 tons of cadmium, and 1.4 million troy ounces of silver.

Copper.—The Territory's second largest producer of copper was Oamites, a joint venture of Falconbridge Nickel Mines Ltd. of Canada (74.9%) and International Development Corp. (IDC) of the Republic of South Africa (25.1%). The Oamites mine, located 55 kilometers south of Windhoek, milled 620,000 tons of ore in 1977 compared with 600,000 tons in 1976. Recoverable copper output increased from 6,400 tons in 1976 to 6,900 tons in 1977. The production increase was owing to the 3% rise in ore milled and the improvement in grade from 1.14% in 1976 to 1.2% in 1977. Despite the rise in output, Oamites suffered losses of approximately $450,000 for the year owing to low metal prices. Reserves at yearend were estimated at 3.5 million tons containing 1.19% copper and 0.50 troy ounce of silver per ton.

Production at the mine owned by Klein Aub Koper Maatskappy Ltd., a subsidiary of General Mining and Finance Corp. Ltd. (Republic of South Africa), was approximately 3,500 tons of recoverable copper. The latest estimate of ore reserves was 8 million tons of copper-silver ore with an average content of 2.5% copper; the mine was reported to remain economic owing to the silver content of the ore.

The Otjihase copper mine, which came onstream in October 1975, was placed on a care-and-maintenance basis on December 22, 1977. The mine suffered losses of approximately $11.5 million in 1977 owing to low metal prices and technical difficulties that prevented Otjihase from reaching full capacity. In 1977, approximately 811,000 tons of ore was milled and 13,580 tons of 22% copper concentrates was produced. In addition, pyrite concentrates were sold to Rössing on a contractual basis. The Otjihase mine, located 27 kilometers northeast of Windhoek, was owned by Johannesburg Consolidated Investment Co. Ltd. (JCI) and Minerts Development (Pty.) Ltd. JCI reduced its shareholding from 52.5% to 49% during the year.

Lead, Zinc, Vanadium.—The major producer of zinc and a secondary producer of lead was the Rosh Pinah mine, operated by Imcor Zinc (Pty.) Ltd., a subsidiary of South African Iron and Steel Industrial Corp. Ltd. (ISCOR). In 1977, its production of both zinc and lead increased substantially. Zinc concentrate production increased from 25,000 tons (with a zinc content of 50.6%) in 1976 to 40,300 tons (with a zinc content of 48.4%) in 1977. Lead concentrate production increased from 7,000 tons in 1976 to 11,900 tons (with a lead content of 45%) in 1977. Mining at Rosh Pinah, located in the Namib Desert about 27 kilometers north of the Orange River, was by open pit methods. In 1977, the zinc output was shipped through Lüderitz Bay to Zinc Corp. of South Africa Ltd.'s (ZINCOR) electrolytic refinery in the Republic of South Africa. Lead concentrate was marketed in the Territory.

The Territory's other producer of lead and zinc and the only producer of vanadium was the Berg Aukas mine, operated by SWACO. At yearend 1976, SWACO was acquired by Kiln Products Ltd., partially owned by Gold Fields of South Africa Ltd. Milling capacity at Berg Aukas was 125,000 tons per year of ore, leading to an average production of 40,000 tons of lead, zinc, and vanadium concentrates. Owing to low metal prices, SWACO was considering placing the underground operations at Berg Aukas on a care-and-maintenance basis in 1978.

Silver.—Domestic production of silver, a byproduct of copper and lead mining, increased to approximately 1.7 million troy ounces in 1977. The largest silver producer was Tsumeb, which recovered 1,404,000 troy ounces in company-produced concentrates (compared with 1,128,000 troy ounces in 1976). The balance of silver production was

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from the Oamites and Klein Aub copper mines. Virtually all silver produced in the Territory was processed by Tsumeb, which then exported it for toll refining elsewhere.

Tin and Tungsten.—The Territory produced 994 tons of tin metal and 150 tons of tungsten metal in 1977. The major tin producer was the Uis tin mine, operated by Industrial Minerals Mining Corp. (Pty.) Ltd., a wholly owned subsidiary of ISCOR. Its production again decreased, from 1,262 tons of tin concentrate (with a tin metal content of 63.4%) in 1976 to 1,247 tons (with a tin metal content of 63.7%) in 1977. Output from the Uis mine, located northeast of Swakopmund near Brandberg, was shipped to ISCOR's smelter at the Vanderbijlpark steelworks in the Republic of South Africa.

The Brandberg West tin-tungsten mine increased its output to about 200 tons of tin and 142 tons of tungsten. Reserves at the mine, operated by SWACO, were estimated at 6.6 million tons grading 0.2% combined tin and tungsten.

Tungsten was the main product at the Krantzberg mine, owned by Nord Resources Corp. (40%) and Ebco Mining Co. (60%), both of the United States. Nord Resources served as operator and marketed all output of Nordex Joint Venture Ltd. Although Krantzberg's production capacity was rated at 7,500 tons per year of concentrates, the plant was reported as operating at much less than capacity. Mill modifications and repairs were in progress at the mine, situated northwest of Windhoek near Omaruru.

Uranium.—Production at the large uranium mine operated by Rössing was 2,760 tons of U_3O_8 in 1977. The mine was originally scheduled to reach full capacity of 5,000 tons of U_3O_8 per year in 1977 but will not achieve this goal until 1979. Since starting up in 1976, Rössing has encountered both labor problems and technical difficulties in the treatment plant. In addition, unsuitable ground conditions and variations in ore grades have lowered output. Plant modification at a cost of $40 million was to rectify problems at the processing plant and allow the plant to reach its rated milling capacity of 40,000 tons per day of ore and also increase recovery to 85%.

The large, low-grade (0.04%) uranium ore body, situated 70 kilometers northeast of Swakopmund, has been under development since 1966. Reserves were estimated at 150,000 tons of U_3O_8. Scheduled to become one of the largest uranium mines in the world when full production is reached, the Rössing mine's initial cost was estimated at $210 million. Open pit mining was to be supplemented by an underground mine to be commissioned after plant changes were effected.

The largest shareholder in the Rössing venture was Rio Tinto-Zinc Corp. Ltd. of the United Kingdom (42.5%). Also holding interest in the mine were IDC, General Mining, and Total Compagnie Minière et Nucleaire (France). Production is to be marketed in Western Europe and Japan. The British Atomic Energy Commission contracted to receive 7,500 tons of U_3O_8 over a period of 5 to 6 years.

Several other companies were active in uranium prospecting in the areas north and east of Swakopmund. General Mining was finalizing details on the exploitation of the Langer Heinrich uranium deposit, located near Tinkas. Testing conducted in a pilot plant during the year indicated no major treatment problems. Gold Fields was assessing reserves at a large deposit at Trekkopje, adjacent to the Rössing property. Anglo-American Corp. of South Africa Ltd., JCI, and Falconbridge were also exploring for uranium in the Territory.

NONMETALS

Cement.—Feasibility studies were in progress in 1977 regarding the construction of a cement plant at Karibib northwest of Windhoek. An initial investment of $23 million was to be made by South-West Africa Portland Cement Co. Ltd., owned by Pretoria Portland Cement Co. Ltd. and Anglo-Alpha Cement Co., both of the Republic of South Africa. Based on local limestone and gypsum deposits, the plant would begin production in 1981.

Diamond.—The value of the diamond production of CDM, a wholly owned subsidiary of De Beers, represented 22% of De Beers' earnings in 1977. The tonnage treated at Oranjemund increased from 12.9 million tons in 1976 to 14.9 million tons in 1977, and the grade increased from 0.1315 carat to 0.1343 carat per ton. Final diamond recovery increased from 1.69 million carats in 1976 to 2 million carats in 1977, of which approximately 95% was gem stones. However, the average stone size decreased from 0.95 carat to 0.72 carat.

The production increase in 1977 was mainly owing to the commissioning of the No. 3 conglomerate plant, which reached full capacity of 360,000 tons per month in

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July, and completion of modifications to the other three plants, which were operating at rated capacity at yearend.

CDM, which has surface-mined marine terraces in the Territory since 1920, officially moved its headquarters from Kimberley, Republic of South Africa, to Windhoek in 1977. The company pledged to devote a proportion of its profits to new projects in the Territory and appropriated $28 million for the purpose of diversifying outside the diamond area. CDM also initiated a comprehensive program of job evaluation at the mines and began construction on a technical institute in Ovamboland.

In January 1978, CDM was to undertake a survey of 100,000 square kilometers in four areas — east of Windhoek, north of Lüderitz, south of Keetmanshoop, and north of Tsumeb — to supplement its previous reconnaissance prospecting. Sampling was also to continue at Arrisdrif, on the northern bank of the Orange River. In 1977, technical problems of sampling marine gravel deposits in deeper water were overcome, and prospecting at sea was to be extended.

Lithium.—In 1977, approximately 2,500 tons of lithium minerals was produced. South-West Africa Lithium Mines (Pty.) Ltd., owned by Klöckner & Co. K.G. (Federal Republic of Germany), began mining lithium in the Karibib area before World War I. At the Rubicon mine, lepidolite, petalite, beryl, and amblygonite were produced by open pit methods. At the Helicon mine, petalite was produced partly by open cast methods and partly by underground operations. Reserves were estimated at 1 million tons of lepidolite ore averaging 2% Li_2O, in addition to further tonnage of high-grade ore. The flotation plant had a capacity of 10,000 tons per year of lepidolite concentrates. Production was exported to Japan and Western Europe.

Stone.—*Marble.*—The Geological Survey, in conjunction with the National Building Research Institute of South Africa, was conducting studies on the suitability of marble reserves for dimension stone quarrying. The most significant occurrences of commercial stone were in the mountains to the northwest and southwest of Karibib, which contained white, colored, and variegated marble deposits of good quality. Deposits at Karibib and east of Swakopmund were being worked on a limited scale for the manufacture of furniture and ornamental items.

MINERAL FUELS

Petroleum.—There was no exploration activity reported in the Territory in 1977. Southern Oil Exploration Corp. (Pty.) Ltd. (SOEKOR), the South African organization entrusted with coordinating oil exploration in both the Republic and the Territory, planned to drill offshore in deep water block 13 in 1978. Holders of petroleum rights included Canada Southern Petroleum Ltd. and Etosha Petroleum Co. Pty. Ltd. All areas not assigned were held by the State company, Southern Oil Exploration Corp. (South-West Africa) (Pty.) Ltd. (SWAKOR), a subsidiary of SOEKOR.

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[1]Economist, Branch of Foreign Data.

[2]Where necessary, values have been converted from South African rand (R) to U.S. dollars at the rate of R1 = US$1.15.

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The Mineral Industry of Spain

By Roman V. Sondermayer[1]

Spain produced a variety of minerals during 1977, among which mercury, pyrite, fluorspar, strontium, gypsum, lead, potash, zinc, and petroleum refinery products were important to the world economy.

Spain's foreign trade balance in minerals was negative, and the country remained dependent on imports of coal, natural gas, crude oil, nonferrous metals, and iron ores to meet its demand.

The mineral industry of Spain, including processing, accounted for 11% of the gross national product (GNP) during 1977; about 1% of the GNP was contributed by the extractive industries alone. Approximately 200,000 persons were employed in the mineral industry of the country. Following the end of the Franco dictatorship, labor unions were in the process of organizing the work force along nontotalitarian lines.

The Government continued to regulate activities of the mineral industry. The Ministry of Industry and Energy's proposed Royal Decree 1102 of 1977, which expanded upon provisions of the Mining Development Law approved in 1976, listed raw minerals by priority status under the National Supply Plan. Phosphate, coal, uranium, copper, tin, iron, lead, nickel, aluminum, asbestos, chromium, manganese, titanium, tungsten, zinc, potash, fluorite, ornamental stone, kaolin, marble, granite, and magnesite were to receive priority for a 2-year period for credits and other measures taken by the Government to stimulate the mineral industry. Furthermore, the Bureau of Energy and Mineral Resources was created within the Ministry of Industry and Energy. The responsibilities of the new Bureau included drafting proposals for the national energy, fuels, and mineral supply plans; determining rates and prices for energy services and products; controlling consumption of raw minerals, including fuels; establishing policies, in cooperation with other Government agencies, on imports of minerals; and taking action to develop mining and energy technology. In addition, the Inter-Ministerial Committee was examining a draft of the Second National Energy Plan for submission to the Parliament. The major purpose of the plan was to lower energy consumption, reduce dependence on imports, diversify energy sources, and foster energy technology.

During 1977, as in the past, the Ministry of Industry and Energy implemented the mineral laws, regulated the private sector, and managed most of the mineral industry through the Instituto Nacional de Industria (INI). In an effort to alleviate economic difficulties resulting from the high cost of imported fuels, INI planned a 26% increase in investments in petroleum sector ventures.

During 1977, the principal events in the mineral industry included construction of an aluminum plant at San Ciprián, development of the Aznacollar copper-mining complex near Sevilla, beginning of production at the Rubiales lead and zinc mine, completion of expansion of the zinc smelter at San Juan de Nieva, and authorization to expand the capacities of several petroleum refineries.

PRODUCTION

Production of mineral commodities for 1975-77 is detailed in table 1.

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Table 1.—Spain: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Aluminum:			
Bauxite	8,500	13,500	10,000
Metal:			
Primary	[r]209,616	210,516	211,167
Secondary	34,500	40,000	40,000
Antimony:			
Mine output, metal content	[r]84	152	324
Metal (regulus)	131	NA	NA
Arsenic, white	[r]11	[e]10	[e]10
Cadmium metal	[r]205	246	303
Copper:			
Mine output, metal content	39,321	35,555	[e]40,000
Metal:			
Blister	142,776	141,276	145,446
Refined:			
Primary:			
Thermal	17,472	18,396	4,254
Electrolytic	121,164	131,868	141,339
Total	138,636	150,264	145,593
Secondary	[r]33	31	29
Gold, mine output, metal content, troy ounces	124,584	148,601	150,144
Iron and steel:			
Ore and concentrate, gross weight, thousand tons	7,641	7,607	7,853
Metal:			
Pig iron, do	6,843	6,624	6,605
Electric furnace ferroalloys, do	285	299	301
Steel:			
Crude, do	11,115	10,910	10,921
Castings and forgings, do	430	347	333
Total, do	11,545	11,257	11,254
Semimanufactures, do	11,281	12,017	12,164
Lead:			
Mine output, metal content	58,518	62,196	61,006
Metal:			
Primary	[r]73,344	75,516	89,177
Secondary	6,415	3,020	NA
Mercury:			
Mine output, metal content, 76-pound flasks	44,010	42,729	35,013
Metal, do	47,039	40,147	31,532
Silver:			
Mine output, metal content, thousand troy ounces	3,447	3,222	[e]3,540
Metal:			
Primary, do	3,054	3,107	NA
Secondary, do	[e]2,050	NA	NA
Tin:			
Mine output, metal content	[r]509	390	469
Metal:			
Primary	[r]8,042	5,369	5,343
Secondary	121	NA	NA
Titanium dioxide	17,143	21,110	39,478
Tungsten, mine output, metal content	[r]397	349	341
Uranium, mine output, U_3O_8 content	225	228	243
Zinc:			
Mine output, metal content	[r]84,132	83,412	96,231
Metal:			
Primary	[r]133,368	158,364	156,628
Secondary	13	NA	NA
NONMETALS			
Barite	77,095	[e r]92,695	[e]80,000
Cement, hydraulic:			
Natural, thousand tons	123	NA	NA
Other, do	23,970	25,202	27,995
Chalk, cubic meters	131,650	115,808	NA
Clays:			
Bentonite	75,351	108,148	[e]110,000
Kaolin, marketable:			
Crude	139,294	[e]140,000	[e]130,000
Washed	207,378	207,180	191,000
Refractory	[r]477,697	NA	NA
Other, thousand cubic meters	7,404	8,517	NA
Diatomite and tripoli	20,370	[e r]17,150	[e]20,000
Feldspar and pegmatite	86,275	90,964	[e]90,000
Fertilizer materials:			
Crude potassic salts, K_2O equivalent	567,040	630,252	563,000

See footnotes at end of table.

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Table 1.—Spain: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
NONMETALS —Continued			
Fertilizer materials —Continued			
Manufactured:			
Nitrogenous, N content thousand tons	608	962	NA
Phosphatic, P_2O_5 content do	[r]456	481	NA
Potassic, K_2O equivalent do	116	346	NA
Other including mixed do	2,877	2,220	NA
Fluorspar:			
Gross weight:			
Acid grade[1]	252,803	221,977	215,916
Metallurgical grade	82,061	e [r]92,000	e90,000
Total	334,864	313,977	305,916
CaF_2 content:			
Acid grade[1]	245,587	215,766	209,837
Metallurgical grade	61,231	69,887	e70,000
Total	306,818	285,653	279,837
Gypsum and anhydrite, crude thousand tons	4,220	e4,200	e4,300
Earth, industrial, n.e.s	25,105	23,046	NA
Kyanite and related materials, and andalusite	5,042	e [r]5,743	e6,600
Lime, hydrated, and quicklime thousand tons	392	e400	e400
Magnesite, crude	342,040	e [r]348,082	e350,000
Meerschaum (sepiolite), crude	71,251	e66,498	NA
Mica	527	e [r]500	--
Pigments, mineral: Ocher	[r]8,432	e8,990	NA
Pumice	139,184	120,839	e120,000
Pyrite, including cuprous:			
Gross weight thousand tons	[r]2,646	2,349	2,404
S content do	[r]1,227	1,052	1,102
Salt:			
Rock do	1,833	1,999	e2,000
Marine and other evaporated do	1,299	1,159	e1,200
Sand and gravel:			
Sand, silica[2] thousand cubic feet	925	991	NA
Other do	12,993	NA	NA
Sodium compounds:			
Sodium carbonate, manufactured	[r]473,124	522,348	320,200
Sodium sulfate:			
Natural:			
Glauberite, Na_2SO_4 content	44,508	55,390	e154,000
Thenardite, Na_2SO_4 content	93,063	108,938	--
Manufactured	[r]141,804	166,380	174,307
Stone:			
Calcareous:			
Dolomite thousand cubic meters	1,218	1,120	NA
Limestone do	39,036	41,219	NA
Marble do	233	289	NA
Marl do	2,878	30,062	NA
Basalt do	1,477	2,763	NA
Granite do	2,817	2,717	NA
Ofite do	353	426	NA
Phonolite do	323	148	NA
Porphyry do	83	126	NA
Quartz thousand tons	626	e598	NA
Quartzite thousand cubic meters	215	249	NA
Sandstone do	615	634	NA
Slate do	550	599	NA
Trachyte do	(3)	--	NA
Trass and tufa do	211	241	NA
Other do	--	16,481	NA
Strontium minerals	8,000	e7,500	e7,500
Sulfur, byproduct:			
Elemental, from petroleum[e]	1,800	4,100	4,500
From lignite gasification[e]	1,400	1,400	1,500
From metallurgy	104,000	122,500	e25,000
Talc and steatite	47,318	47,617	e50,000
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	18,504	e12,065	NA
Carbon black	40,862	50,336	52,745
Coal:			
Anthracite thousand tons	3,154	3,548	3,663
Bituminous do	[r]7,469	6,969	8,042
Lignite do	3,380	4,150	5,788
Total do	[r]14,003	14,667	17,493

See footnotes at end of table.

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Table 1.—Spain: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS —Continued			
Coke:			
Metallurgical thousand tons	4,861	4,423	4,381
Gashouse do	--	(4)	--
Fuel briquets, all types do	12	9	7
Gas:			
Natural, marketed million cubic feet	[r]42	41	[e]40
Manufactured:			
Gasworks do	27,248	NA	NA
Coke oven do	[r]69,463	NA	NA
Blast furnace do	[e]100,000	NA	NA
Total do	[r]196,711	NA	NA
Peat	34,176	30,552	[e]30,000
Petroleum:			
Crude thousand 42-gallon barrels	14,822	11,552	6,898
Refinery products:			
Motor gasoline do	40,077	44,288	44,750
Kerosine do	1,940	1,284	2,264
Jet fuel do	17,157	17,489	16,282
Distillate fuel oil do	62,720	77,221	96,434
Residual fuel oil do	139,716	163,758	137,246
Lubricants, including grease do	1,734	1,677	1,791
Other do	36,497	48,388	39,170
Refinery fuel and losses do	17,083	22,032	16,896
Total do	316,924	376,137	354,833

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]Includes recorded production of salable acid-grade fluorspar from both fluorspar mines and lead-zinc mines, and some salable acid-grade fluorspar obtained by beneficiating a portion of total reported salable metallurgical-grade fluorspar.

[2]Includes sand obtained from kaolin.

[3]Less than 1/2 unit.

[4]Revised to none.

TRADE

Spain's mineral commodity trade for 1975 and 1976 is shown in tables 2 and 3. United States-Spanish trade for 1976 is shown in table 4.

Table 2.—Spain: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Oxide and hydroxide	59	53	Portugal 26; United Kingdom 20.
Metal including alloys:			
Scrap	273	215	West Germany 99; France 95; Italy 20.
Unwrought	2,389	10,805	United States 4,408; United Kingdom 3,041.
Semimanufactures	6,547	13,240	United States 3,715; France 1,565.
Antimony metal including alloys, all forms	139	323	France 128; Netherlands 106; United Kingdom 37.
Arsenic trioxide, pentoxide, acids	2	2	All to Libya.
Cadmium metal including alloys, all forms	176	172	Belgium-Luxembourg 79; France 74.
Chromium oxide and hydroxide	18	30	Greece 9; Switzerland 9; Colombia 6.
Copper:			
Ore and concentrate	3	1,141	All to Bulgaria.
Matte	NA	626	All to Belgum-Luxembourg.
Copper sulfate	2	(1)	Mainly to Argentina and Venezuela.
Metal including alloys:			
Scrap	141	102	West Germany 45; United Kingdom 40; France 12.
Unwrought	17,230	34,433	France 19,402; United Kingdom 5,875.
Semimanufactures	8,207	6,095	France 2,280; Iran 730.
Iron and steel:			
Ore and concentrate, except roasted pyrites thousand tons	1,960	2,188	West Germany 825; Romania 438; France 347.

See footnotes at end of table.

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Table 2.—Spain: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Iron and steel —Continued			
Roasted pyrite thousand tons	531	628	West Germany 474; Spain 125.
Metal:			
Scrap	1,529	466	France 267; West Germany 62; Switzerland 54.
Sponge iron, powder, shot	6,162	6,498	France 2,117; West Germany 1,256; Italy 1,216.
Ferroalloys:			
Ferromanganese	17,215	39,533	United States 10,375; West Germany 6,254; Sweden 4,046.
Other	25,432	39,793	West Germany 13,404; United Kingdom 6,885; Romania 5,185.
Steel, primary forms	15,603	80,121	United States 30,047; Brazil 25,355; Yugoslavia 7,788.
Semimanufactures:			
Bars, rods, angles, shapes, sections	1,109,000	1,499,000	Iran 237,537; Poland 209,949; West Germany 197,925.
Universals, plates, sheets	279,237	651,976	West Germany 150,620; United States 143,564; Brazil 89,468.
Hoop and strip	6,803	16,362	France 13,487; Portugal 1,062.
Rails and accessories	14,624	15,192	Egypt 14,451.
Wire	7,642	13,439	Algeria 4,645; France 3,939; Italy 922.
Tubes, pipes, fittings	128,381	167,378	France 57,480; West Germany 25,880; People's Republic of China 21,027.
Castings and forgings, rough	14,624	10,806	West Germany 1,823; France 1,712; Belgium-Luxembourg 998.
Lead:			
Oxide	1	5	West Germany 4; Andorra 1.
Metal including alloys:			
Scrap	NA	10	All to United Kingdom.
Unwrought	1,564	1,444	Netherlands 1,232.
Semimanufactures	74	98	Algeria 44; Andorra 20; Morocco 14.
Manganese:			
Ore and concentrate	24	125	West Germany 53; Portugal 45; Morocco 22.
Oxide	1,769	1,722	Mainly to France.
Metal	20	--	
Mercury 76-pound flasks	18,826	23,265	United States 4,554; Romania 4,032; India 3,191.
Molybdenum metal including alloys, all forms	3	1	All to Mauritania.
Nickel metal including alloys:			
Scrap	462	652	West Germany 344; France 196; Belgium-Luxembourg 88.
Unwrought	14	44	Netherlands 40.
Semimanufactures	42	33	West Germany 31.
Platinum-group metals and silver:			
Waste and sweepings kilograms	NA	38	All to France.
Metals including alloys:			
Platinum-group troy ounces	3,569	385,808	All to Switzerland.
Silver thousand troy ounces	1,029	225	Denmark 193.
Selenium, elemental kilograms	300	800	Portugal 700.
Tin:			
Ore and concentrate	NA	10	All to West Germany.
Metal including alloys:			
Scrap	33	124	All to United Kingdom.
Unwrought	1,573	2,489	Netherlands 1,829.
Semimanufactures	10	2	Portugal 1.
Titanium oxide	4,784	7,061	West Germany 1,970; France 1,911; United Kingdom 803.
Tungsten:			
Ore and concentrate	573	467	West Germany 220; United Kingdom 122; Netherlands 52.
Metal including alloys, all forms	23	14	West Germany 7; Switzerland 5.
Zinc:			
Ore and concentrate	7,379	6,545	West Germany 5,235; Canada 720.
Oxide	333	776	Belgium-Luxembourg 385; West Germany 201; France 80.
Metal including alloys:			
Blue powder	881	465	United States 401.
Unwrought and semimanufactures	30,757	34,789	United States 25,069.
Other:			
Ores and concentrates of molybdenum, tantalum, titanium, vanadium, zirconium	184	20	Netherlands 14; United States 5.
Ash and residue containing nonferrous metals	17,069	23,247	East Germany 12,459; Norway 4,400; Republic of South Africa 2,785.
Oxides, hydroxides, peroxides of metals	398	9,225	Algeria 3,804; Kuwait 2,500; Saudi Arabia 2,024.

See footnotes at end of table.

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Table 2.—Spain: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Other —Continued			
Metals including alloys, all forms:			
Alkali, alkaline earth, rare-earth metals	(1)	(1)	NA.
Pyrophoric alloys	(1)	(1)	NA.
Base metals including alloys, all forms, n.e.s	337	511	Netherlands 193; France 134; Belgium-Luxembourg 84.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	784	317	West Germany 119; France 79; Syria 32.
Dust and powder of precious and semiprecious stones, except diamond value, thousands	$408	--	
Grinding and polishing wheels and stones	1,824	2,068	West Germany 898; Cuba 145.
Asbestos	162	5	Andorra 4; Mexico 1.
Barite and witherite	50,675	52,801	West Germany 46,111.
Boron materials, oxide and acid	252	16	West Germany 10; Egypt 6.
Cement thousand tons	3,682	4,889	Algeria 981; Morocco 681; Ivory Coast 377.
Chalk	3,745	5,376	Portugal 2,823; Libya 2,400.
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite	24,200	25,560	Portugal 10,453; Netherlands 2,425; France 2,253.
Kaolin (china clay)	47,698	59,237	Italy 21,076; West Germany 16,491; France 8,883.
Other	10,556	10,419	Andorra 3,757; Portugal 1,649; Italy 1,057.
Products:			
Refractory (including nonclay brick)	13,439	12,333	Cuba 4,216; Egypt 1,802; Morocco 1,450.
Nonrefractory	269,436	273,105	France 56,687; West Germany 40,274; Libya 22,479.
Diamond, industrial, including powder value, thousands	$620	$9,597	Belgium-Luxembourg $5,483; Mexico $3,098.
Diatomite and other infusorial earth	1,239	2,919	Netherlands 1,324; Belgium-Luxembourg 435; France 415.
Feldspar, leucite, nepheline, nepheline syenite	1,406	2,747	France 2,274.
Fertilizer materials:			
Crude and manufactured:			
Nitrogenous	14,121	190,029	Belgium-Luxembourg 90,371; West Germany 34,844; United States 20,035.
Phosphatic	NA	100	All to Portugal.
Potassic	127,982	408,630	United Kingdom 67,439; Norway 59,575; Portugal 47,165.
Other	15,116	109,774	Turkey 43,437; Venezuela 37,600; Belgium-Luxembourg 19,850.
Ammonia	17	19	Mauritania 15.
Fluorspar	224,302	226,175	United States 139,607; West Germany 28,216.
Graphite, natural	88	226	West Germany 156; Belgium-Luxembourg 69.
Gypsum and plaster	133,096	363,196	Denmark 147,437; Sweden 107,162.
Iodine	1	1	All to Turkey.
Lime	8,311	6,214	Morocco 5,872.
Magnesite	87,360	74,261	United Kingdom 36,403; West Germany 21,620.
Mica, all forms	1,164	2,236	United Kingdom 1,812.
Pigments, mineral, including processed iron oxides	9,991	10,330	United Kingdom 1,921; Australia 920; United States 918.
Precious and semiprecious stones, except diamond:			
Natural value, thousands	$111	$83	Switzerland $40.
Manufactured do	$1,054	$291	Switzerland $251.
Pyrite, gross weight thousand tons	208	335	Belgium-Luxembourg 215; West Germany 75.
Salt and brine do	37	346	United States 208; Denmark 23.
Sodium and potassium compounds	41,168	63,957	Morocco 6,389; Turkey 6,078; Italy 4,930.
Stone, sand and gravel:			
Dimension stone:			
Crude or partly worked:			
Calcareous	11,664	15,927	Italy 9,635.
Slate	298	1,483	France 887; West Germany 563.
Other	29,950	39,315	Italy 21,302; France 11,318; West Germany 4,984.
Worked:			
Slate	83,398	120,441	France 106,084.

See footnotes at end of table.

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Table 2.—Spain: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Stone, sand and gravel —Continued			
Dimension stone —Continued			
Worked —Continued			
Paving stone and flagstone	36	42	Portugal 17; Saudi Arabia 15.
Other	15,920	15,206	West Germany 10,120; France 2,590.
Dolomite	26,922	89,052	Liberia 59,368; United Kingdom 29,276.
Gravel and crushed rock	37,922	161,018	Gabon 78,609; Andorra 60,450; Ivory Coast 19,850.
Quartz and quartzite	270,118	281,547	Norway 247,398; Sweden 33,570.
Sand, excluding metal bearing	78,713	138,750	Andorra 133,036.
Sulfur:			
Elemental, all forms	175	11,224	Algeria 9,753.
Sulfur dioxide	59	210	Algeria 165; Portugal 45.
Sulfuric acid	15,476	25,708	Morocco 11,496; France 5,373; Turkey 2,923.
Talc, steatite, soapstone, pyrophyllite	1,938	4,775	U.S.S.R. 3,273; West Germany 1,000.
Other:			
Crude:			
Meerschaum, amber, jet	68,714	114,837	West Germany 44,680; France 26,594; United Kingdom 23,385.
Other	349,189	347,059	France 232,028; Belgium-Luxembourg 84,226.
Slag, dross, and similar waste, not metal bearing	30,042	22,071	Portugal 20,350.
Oxides and hydroxides of magnesium, strontium, barium	1,241	123	West Germany 47; Canada 36; United States 36.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	62,725	79,568	Cuba 31,456; France 19,489; Nigeria 9,342.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	7	(1)	NA.
Carbon black and gas carbon	2,719	6,069	Portugal 3,820; France 1,798.
Coal and briquets:			
Anthracite and bituminous coal	18,922	14,303	Belgium-Luxembourg 13,870.
Lignite and lignite briquets	96	159	Andorra 150.
Coke and semicoke	14,599	—	
Hydrogen, helium, rare gases	88	558	Belgium-Luxembourg 235; Italy 228; France 91.
Peat, including peat briquets and litter	100	(1)	NA.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	2,156	1,810	All to Kuwait.
Refinery products:			
Gasoline, including natural ——do——	4,106	2,879	Netherlands 1,162; United Kingdom 473.
Kerosine and jet fuel ——do——	798	726	Zaire 674.
Distillate fuel oil ——do——	9,556	7,500	West Germany 1,871; Netherlands 1,467; United Kingdom 1,010.
Residual fuel oil ——do——	2,451	534	Mainly to United States.
Lubricants ——do——	167	296	Saudi Arabia 62; Greece 61; Nigeria 42.
Other:			
Liquefied petroleum gas ——do——	962	410	Portugal 291.
Mineral jelly and wax ——do——	79	9	All to Netherlands.
Bitumen and other residues ——do——	1,127	1,931	Libya 608; West Germany 405; Nigeria 256.
Bituminous mixtures, n.e.s ——do——	261	261	Libya 172; Sudan 32.
Pitch and pitch coke ——do——	55	59	France 53.
Unspecified ——do——	406	140	Syria 70; Portugal 35.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	17,879	NA	

NA Not available.
[1]Less than 1/2 unit.

Table 3.—Spain: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite and concentrate	118,906	95,027	Guyana 42,432; Greece 17,140; Ghana 16,648.
Oxide and hydroxide	455,543	408,639	Guinea 211,867; West Germany 74,527; France 57,150.

See footnotes at end of table.

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Table 3.—Spain: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Aluminum —Continued			
Metal including alloys:			
Scrap	4,320	2,861	Portugal 1,983; United States 524.
Unwrought	28,591	14,428	Norway 4,938; U.S.S.R. 4,107; Canada 1,000.
Semimanufactures	8,581	9,869	West Germany 1,953; United States 1,340; Belgium-Luxembourg 1,323.
Antimony:			
Ore and concentrate	335	992	Morocco 313; Thailand 239; Bolivia 120; Ecuador 105.
Metal including alloys, all forms	137	99	Bolgium-Luxembourg 36; Czechoslovakia 33; Turkey 12.
Arsenic:			
Trioxide, pentoxide ,acids	455	610	France 475; Belgium-Luxembourg 80.
Metal including alloys, all forms	15	5	All from Sweden.
Beryllium metal including alloys, all forms kilograms	38	1,308	France 1,000; United States 308.
Bismuth metal including alloys, all forms	4	156	West Germany 49; Mexico 31; Republic of Korea 23.
Cadmium metal including alloys, all forms	1	1	All from United States.
Chromium:			
Chromite	98,261	117,392	Turkey 67,697; Albania 6,166.
Oxide and hydroxide	219	188	West Germany 117; U.S.S.R. 59.
Metal including alloys, all forms	13	35	West Germany 17; United States 12.
Cobalt oxide and hydroxide	109	218	United States 75; Belgium-Luxembourg 55; Canada 48; France 23.
Copper:			
Ore and concentrate	142,827	174,126	Australia 92,276; Chile 21,294; Cyprus 19,571.
Matte	27,439	25	All from France.
Copper sulfate	2,365	1,604	France 701; U.S.S.R. 400; Belgium-Luxembourg 352.
Metal including alloys:			
Scrap	16,149	8,740	France 3,420; United States 2,755; Canada 901.
Unwrought	54,931	44,794	Chile 22,209; Belgium-Luxembourg 14,602.
Semimanufactures	13,240	18,243	Italy 2,444; United Kingdom 2,395; Chile 2,375.
Gold:			
Waste and sweepings kilograms	68	7	All from West Germany.
Metal, unworked or partly worked thousand troy ounces	1,157	1,543	United Kingdom 868; Switzerland 482.
Iron and steel:			
Ore and concentrate, except roasted pyrite thousand tons	6,135	6,149	Brazil 2,296; Venezuela 868; Liberia 772.
Roasted pyrite	70,762	7	All from Italy.
Metal:			
Scrap thousand tons	2,198	2,657	United States 1,768; United Kingdom 212.
Pig iron, including cast iron do	35	54	Brazil 12; United Kingdom 10.
Sponge iron, powder, shot do	7	9	Sweden 5; France 3.
Ferroalloys do	21	26	Sweden 3; France 2; West Germany 2.
Steel, primary forms do	1,202	2,146	Japan 1,351; Australia 387; Romania 123.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	219	165	Japan 47; United Kingdom 28; West Germany 22.
Universals, plates, sheets do	317	251	West Germany 66; France 61; Netherlands 31.
Hoop and strip do	41	54	France 30; West Germany 10; Belgium-Luxembourg 4.
Rails and accessories do	4	2	United Kingdom 1.
Wire do	13	13	Belgium-Luxembourg 4; West Germany 3; France 2.
Tubes, pipes, fittings do	89	99	France 46; West Germany 20; Italy 10.
Castings and forgings, rough do	2	1	Mainly from Switzerland and France.
Lead:			
Ore and concentrate	26,028	17,887	Denmark 5,251; Morocco 5,240; Poland 2,958.
Oxide	243	251	Bulgaria 200; Mexico 49.
Metal including alloys:			
Scrap	454	2,494	France 818; United States 502; Canada 401.
Unwrought	6,848	8,995	United Kingdom 4,040; France 1,602; Canada 1,200.
Semimanufactures	179	214	Morocco 147; West Germany 34.
Magnesium metal including alloys, all forms	1,137	706	United States 314; Norway 138; France 101.

See footnotes at end of table.

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Table 3.—Spain: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Manganese:			
Ore and concentrate	437,379	410,151	Ghana 109,453; Gabon 82,686; Republic of South Africa 69,982.
Oxide	1,417	842	United States 611; Belgium-Luxembourg 147.
Metal	487	649	Republic of South Africa 358; Japan 231.
Mercury 76-pound flasks	11	29	All from France.
Molybdenum metal including alloys, all forms	22	27	United States 7; Austria 6; West Germany 4.
Nickel:			
Ore and concentrate	NA	64	NA.
Matte, speiss, similar materials	212	234	Finland 96; Norway 66; Canada 47.
Metal including alloys:			
Scrap	114	--	
Unwrought	4,785	7,724	Canada 2,891; Cuba 2,373; United Kingdom 1,094.
Semimanufactures	3,061	1,901	France 762; West Germany 537.
Platinum-group metals and silver:			
Ores and concentrates	6,668	3,040	Australia 2,606.
Waste and sweepings	499	353	United States 237; France 102.
Metals including alloys:			
Platinum-group troy ounces	r257,206	160,754	Brazil 96,452; France 32,151.
Silver thousand troy ounces	4,662	4,887	West Germany 1,157; Belgium-Luxembourg 1,124; France 789.
Rare-earth metals:			
Oxides	112	204	France 172; United Kingdom 28.
Metals including alloys	7	20	West Germany 9; Brazil 4; France 3.
Selenium, elemental	16	35	Japan 12; West Germany 6; United States 6; Norway 4.
Silicon, elemental	9	3	Belgium-Luxembourg 2; West Germany 1.
Tellurium, elemental	2	2	West Germany 1; U.S.S.R. 1.
Tin:			
Ore and concentrate	7,467	7,486	Belgium-Luxembourg 4,800; Indonesia 1,008; Malaysia 857.
Oxide	75	148	United Kingdom 95; West Germany 45.
Metal including alloys	93	104	United Kingdom 51; Malaysia 15.
Titanium:			
Ore and concentrate	54,851	101,302	Norway 65,005; Australia 23,708; Malaysia 857.
Oxide	1,547	2,216	West Germany 769; France 533; United Kingdom 420.
Tungsten:			
Ore and concentrate	27	--	
Metal including alloys, all forms	8	11	Austria 2; France 1; Ireland 1.
Uranium and thorium:			
Oxide	1	1	NA.
Metals including alloys, all forms kilograms	493	586	All from United States.
Vanadium:			
Pentoxide	15	36	United States 34.
Metal including alloys, all forms	2	1	All from United States.
Zinc:			
Ore and concentrate	137,901	117,814	Peru 63,211; Denmark 24,140; Sweden 10,183.
Oxide and peroxide	346	354	West Germany 286; Italy 44.
Metal including alloys, all forms	117	284	United Kingdom 204.
Zirconium metal including alloys, all forms	5	2	France 1; United States 1.
Other:			
Ores and concentrates Of molybdenum, tantalum, titanium, vanadium, zirconium	15,917	13,433	Australia 12,233.
Ash and residue containing nonferrous metals	20,415	28,568	Belgium-Luxembourg 10,309; United States 6,529; Canada 2,548.
Oxides, hydroxides, peroxides of metals	1,744	2,283	West Germany 888; France 529; United Kingdom 236.
Metals including alloys, all forms:			
Alkali and alkaline earth	148	210	West Germany 192.
Pyrophoric alloys	8	891	Mainly from France.
Base metals including alloys, all forms, n.e.s	1,133	1,462	United States 266; Belgium-Luxembourg 152.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	1,448	751	France 320; United States 221; Italy 150.
Dust and powder of precious and semiprecious stones, except diamond value, thousands	$37	$1	Mainly from Netherlands and United Kingdom.
Grinding and polishing wheels and stones	1,480	1,235	United Kingdom 272; France 239; Italy 231.

See footnotes at end of table.

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Table 3.—Spain: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Asbestos	94,114	113,053	Republic of South Africa 47,362; Canada 37,704; U.S.S.R. 11,015.
Barite and witherite	885	10,197	Morocco 9,250.
Boron materials:			
Crude natural borates	68,723	74,106	Turkey 39,306; United States 34,800.
Oxide and acid	183	320	France 166; United States 152.
Bromine	r22	11	All from Israel.
Cement	100,228	83,489	United Kingdom 58,121; United States 13,071; France 6,099.
Chalk	5,415	7,399	France 6,660.
Clay and clay products (including all refractory brick):			
Crude:			
Bentonite	49,873	38,833	Italy 13,131; Morocco 11,169; Greece 8,040.
Kaolin (china clay)	121,370	134,444	United Kingdom 99,068; France 19,468.
Other	60,757	59,010	United Kingdom 30,250; France 9,692; Morocco 8,592.
Products:			
Refractory (including nonclay brick)	55,389	54,504	Italy 21,229; West Germany 14,181; Austria 7,011.
Nonrefractory	23,072	31,071	Italy 20,344; France 4,612.
Cryolite and chiolite	1,875	320	Denmark 300.
Diamond, industrial:			
Natural value, thousands	$15,004	$4,044	United States $1,160; Republic of South Africa $1,101; Ireland $763.
Manufactured do	$310	$283	Republic of South Africa $251; Belgium-Luxembourg $31.
Diatomite and other infusorial earth	2,815	2,434	United States 1,551; France 720.
Feldspar, leucite, nepheline, nepheline syenite	16,633	13,452	France 10,600; Canada 1,841.
Fertilizer materials:			
Crude:			
Nitrogenous	31,662	190,610	Chile 54,882; West Germany 47,277; Netherlands 25,324.
Phosphatic thousand tons	1,068	1,367	Mainly from Morocco.
Potassic	84,763	5	West Germany 3; France 2.
Manufactured:			
Nitrogenous	77,086	135,728	West Germany 51,250; Netherlands 25,325; France 7,142.
Phosphatic	18,031	17,959	Belgium-Luxembourg 9,143; France 7,142.
Potassic	84,764	NA	
Other, including mixed	4,104	53,953	United States 40,920.
Fluorspar	9	57	United Kingdom 42; East Germany 15.
Graphite, natural	1,546	1,501	Madagascar 793; West Germany 247.
Gypsum and plaster	3,230	3,351	France 1,530; Morocco 1,845; United Kingdom 353.
Iodine	32	84	Japan 43; Chile 41.
Lime	168	138	United States 72; France 62.
Magnesite	61,970	42,362	Greece 14,099; Italy 10,643; United Kingdom 7,670.
Mica, all forms	1,021	1,201	France 309; Norway 219; Austria 151.
Pigments, mineral, including processed iron oxides	4,448	5,650	West Germany 3,995; France 735.
Precious and semiprecious stones, except diamond, manufactured value, thousands	$4,154	$521	Austria $267; Switzerland $124; France $88.
Pyrite, gross weight	112	66	Mainly from Italy.
Salt and brine	5,854	2,629	Netherlands 1,603; United Kingdom 613; France 312.
Sodium and potassium compounds	18,150	10,063	Italy 6,563; France 2,890.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	75,544	89,676	Italy 58,648; Portugal 27,175.
Slate	38	20	All from France.
Other	25,108	23,175	Norway 7,175; Republic of South Africa 3,355; Finland 3,326.
Worked:			
Slate	119	230	Italy 210.
Paving stone and flagstone	14	267	Belgium-Luxembourg 142; Italy 61; West Germany 57.
Other	3,646	6,810	Portugal 2,305; Italy 2,133.
Dolomite, chiefly refractory grade	2,702	3,815	France 1,786; Norway 1,678.
Gravel and crushed rock	26,540	19,521	France 2,979.
Quartz and quartzite	3,272	3,015	Belgium-Luxembourg 918; Yugoslavia 501; West Germany 377.
Sand, excluding metal bearing	34,735	17,298	Morocco 5,664; France 4,644; West Germany 3,140.

See footnotes at end of table.

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Table 3.—Spain: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Sulfur:			
Elemental:			
Other than colloidal	66,675	92,583	France 49,685; Poland 13,244; Canada 9,640.
Colloidal	120	42	Mainly from West Germany.
Sulfur dioxide	(1)	(1)	NA.
Sulfuric acid	13,967	121,634	West Germany 85,921; Finland 17,402.
Talc, steatite, soapstone, pyrophyllite	8,708	12,283	France 8,664; Norway 1,787.
Other:			
Slag, dross, and similar waste, not metal bearing	6,735	1,896	France 1,203; West Germany 616.
Oxides and hydroxides of magnesium, strontium, barium	611	1,065	France 528; West Germany 154; Japan 138.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	2,320	2,747	France 1,264; Canada 568.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	786	743	United States 676.
Carbon black and gas carbon	15,699	15,315	France 7,613; Netherlands 3,281.
Coal and briquets:			
Anthracite and bituminous coal ... thousand tons	3,974	4,548	United States 2,367; Poland 1,601; Australia 348.
Briquets of anthracite and bituminous coal	10	(1)	NA.
Lignite and lignite briquets	r15,548	19,695	All from France.
Coke and semicoke	396,582	352,041	Italy 127,848; United States 66,589.
Gas, natural, liquefied ... thousand cubic feet	59,152	87,874	Libya 64,079; Algeria 21,285.
Hydrogen, helium, rare gases	8	188	West Germany 171.
Peat, including peat briquets and litter	4,739	5,740	West Germany 2,091; Ireland 837; Poland 742.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	289,422	359,445	Saudi Arabia 129,002; Iran 76,294; Libya 35,623.
Refinery products:			
Gasoline, including natural ... do	510	611	Chile 175; Italy 151; Netherlands 118.
Kerosine ... do	(1)	154	Italy 147.
Distillate fuel oil ... do	1,634	762	U.S.S.R. 439; Romania 147; Italy 50.
Residual fuel oil ... do	3,796	2,503	U.S.S.R. 519; Italy 407; Poland 278.
Lubricants ... do	406	266	United Kingdom 91; Netherlands 60; United States 34.
Other:			
Liquefied petroleum gas ... do	61,235	12,619	France 7,825; Algeria 1,134; Saudi Arabia 793.
White spirit ... do	43	8	West Germany 4; Netherlands 3.
Mineral jelly and wax ... do	79	177	France 49; West Germany 29; United States 24.
Bitumen and other residues ... do	2	2	France 1.
Bituminous mixtures ... do	6	23	France 21.
Pitch, pitch coke, petroleum coke ... do	1,628	1,716	United States 1,000; West Germany 457; United Kingdom 231.
Unspecified ... do	889	93	United States 37; Belgium-Luxembourg 24; Netherlands 20; West Germany 10.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals ... thousand tons	119	135	United States 92; Italy 11; West Germany 10.

rRevised. NA Not available.
1Less than 1/2 unit.

Table 4.—Spain: Mineral trade with the United States, 1976[1]

Commodity	Exports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
METALS				
Aluminum metal including alloys	8,005	$6,942	1,197	$2,881
Copper metal including alloys	93	439	1,323	2,758

See footnotes at end of table.

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Table 4.—Spain: Mineral trade with the United States, 1976[1] —Continued

Commodity	Exports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
METALS —Continued				
Iron and steel metal:				
Scrap	--	--	1,670,503	136,692
Ferroalloys	23,100	9,762	476	2,237
Steel, primary forms	21,906	5,389	2,064	695
Semimanufactures:				
Bars and angles	35,643	12,602	1,600	642
Plates and sheets	133,993	27,557	11,096	3,939
Hoop and strip	341	80	15,573	4,276
Rails	--	--	55	13
Wire	547	506	388	656
Tubes and pipes	6,365	3,391	8,912	17,936
Castings and forgings	411	384	124	444
Lead metal including alloys	163	422	38	42
Lead-zinc ores and concentrates	--	--	5,029	1,070
Manganese ore and concentrate	--	--	16,222	855
Mercury	166	461	--	--
Molybdenum ore and concentrate	--	--	46	196
Nickel metal including alloys	--	--	43	438
Platinum-group metals and silver:				
Ores	NA	3	316	714
Metals:				
Platinum-group	NA	(2)	--	--
Silver metal including alloys	--	--	6	594
Radioactive and associated materials	NA	5	95	5,105
Tin metal including alloys	85	96	NA	1
Zinc metal including alloys	27,346	20,234	11	27
Other nonferrous metals:				
Ores and concentrates, n.e.s	40	357	59	180
Metals:				
Base metals including alloys, n.e.s	67	298	601	1,190
Scrap	508	352	14,515	12,098
NONMETALS				
Abrasives, natural, including diamond	--	--	2,470	1,279
Asbestos, all forms	--	--	246	129
Cement	293,336	5,630	--	--
Clays and refractory materials	4,511	494	13,498	1,325
Diamond and precious stones	NA	153	2	1,501
Fertilizer materials:				
Crude, phosphatic	--	--	16,249	424
Manufactured, potash	19,880	850	--	--
Ammonia, anhydrous	--	--	18,144	1,859
Quartz, mica, feldspar, etc	101,707	8,445	--	--
Salt, sodium chloride	228,905	1,135	--	--
Stone, sand and gravel:				
Dimension stone	685	165	--	--
Crushed and broken stone, sand and gravel	40	5	481	100
Sulfur:				
Sulfur and unroasted pyrites	--	--	6,474	266
Sulfuric acid	--	--	2	2
Other, crude	75	2	26,196	3,274
MINERAL FUELS AND RELATED MATERIALS				
Coal, all types	--	--	2,216,557	126,167
Coke	--	--	23,530	965
Petroleum refinery products:				
Residual fuel oil	59,265	4,578	--	--
Lubricants	--	--	2,365	2,466
Petroleum jelly and mineral waxes	--	--	3,230	1,074
Petroleum coke, asphalt, etc	--	--	38,510	12,178
Total	XX	110,737	XX	348,188

NA Not available. XX Not applicable.
[1]Data may differ from those reported elsewhere in this chapter owing to a difference in source.
[2]Less than 1/2 unit.

Source: U.S. Department of Commerce, Bureau of the Census.

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COMMODITY REVIEW

METALS

Aluminum.—Construction proceeded on the alumina-aluminum complex at San Ciprián (Lugo Province) owned by Aluminio Español S.A. When it goes into operation in 1978 or 1979, annual production should reach 800,000 tons of alumina and 175,000 tons of aluminum. The plants were built so that annual capacity could be doubled for alumina and increased to 270,000 tons for aluminum. Empresa Nacional de Aluminio S.A. (ENDASA), a Government corporation, controlled by INI, owned 55% of Aluminio Español S.A.

During 1977, four primary aluminum smelters were in operation. ENDASA was the major producer of aluminum in the country and operated Spain's largest smelter, a 110,000-ton-per-year plant near Àviles. Spain, with its modest production of bauxite, remained largely dependent on imports to meet the demand of domestic smelters.

Copper.—The major activities of Spain's copper industry were at the Aznacollar mining complex near Sevilla, operated by Andaluza de Piritas S.A. (APIRSA). Preparation of the mine for production continued during 1977. Planned annual production targets for the opencast mine were set at 2 million tons of complex sulfide ores, mostly pyrites, and 1.5 million tons of copper pyroclasts. The overburden-to-ore ratio is expected to be 3.2:1. A new pilot plant went onstream during the year, and a flotation plant was planned near the mine which was expected to annually yield about 51,000 tons of copper concentrates, 42,000 tons of lead concentrates, and 98,000 tons of zinc concentrates. Proven reserves of the deposit amounted to 78.5 million tons. Approximately 44.5 million tons of this was complex sulfide ore with 0.58% copper, 1.78% lead, 3.33% zinc, and 57 grams silver per ton; the remainder was cupriferous pyrite ore with about 0.58% copper, 0.40% lead, and 10 grams silver per ton. The completion date for all segments of the complex was set back to 1980 or later because of metallurgical problems.

Iron Ore.—Exploration of the iron ore deposit found during 1975 in the Marquesado zone of Granada Province (in southern Spain near the Alquife mines continued during 1977. Reports indicated reserves of about 30 million tons of high-grade ore. An annual production of 1 million tons is planned for the new mine. Expansion of capacities was underway at the following mines: Andaluza de Minas (Granada Province), Mineral del Andevalo (Huelva and Badajoz Provinces), Agraminas (near Bilbao, Vizcaya Province), and Sierra Minera (Teruel and Guadalajara Provinces). By 1982, when all these projects are completed, Spain will have an additional iron ore capacity of about 32 million tons of ore per year. Most of Spain's current iron ore production comes from León, Teruel, Vizcaya, and Guadalajara Provinces.

Iron and Steel.—During 1977, Empresa Nacional Siderúrgica S.A. (ENSIDESA) remained the principal steel producer in the country. ENSIDESA, with plants located at Àviles, La Felguera, Gijón-Moreda, and Gijón-Verina, accounted for approximately 44% of the country's pig iron production and about 45% of the steel output.

There were no installations for direct reduction of iron ore in operation during 1977. However, two plants were planned. One installation, with two modules using natural gas as reductant, will be located in northern Spain near the port of Bilbao. The other facility, with one module using manufactured gas as reductant, will be located in the Bay of Algeciras in southern Spain. Both projects are planned to start operation at the end of 1980, with an aggregate capacity of 1.5 million to 1.7 million tons per year.

Lead and Zinc.—The beginning of production at the new 900,000-ton-per-year lead and zinc ore mine at Rubiales (Lugo Province, in northwestern Spain) was the major event in the lead and zinc sector. The exploration and development program at Rubiales was started in 1965 by Explaración Minera Internacional España S.A. (Exmines), a consortium made up of Cominco Europe N.V. 47.48%, Holdings Nominees Pty. Ltd. 21.59%, Asturiana de Zinc S.A. 20.00%, Banco Urquijo S.A. 5.04%, Union Corp. S.A. (Luxembourg) 4.40%, Negocios y Fiducias 0.31%, and Gunnex Ltd. 0.18%; the remaining 1% is held by private owners. Cominco Europe, a wholly owned subsidiary of Cominco Ltd. of Vancouver, British Columbia, Canada, provided technical services during development of the Rubiales mine. After about 13 years of work, an underground mine and a mill with a selective

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flotation plant were brought onstream during 1977. The mine is rated at 124,000 tons of zinc concentrates and 17,000 tons of lead concentrates per year.

A description of the Rubiales mine was published during the year.[2] Rubiales ores, primarily lead and zinc sulfides with very little iron, occur in the silicified limestone in the drag-folded eastern flank of an anticline that plunges about 15°. Ore is generally 10 to 25 meters thick in the upper ore blocks and is up to 30 meters thick in the lower levels. Proven reserves were reported at 12 million tons with an average content of 8.1% zinc and 1.5% lead.

The main shaft at Rubiales is equipped with a four-rope, friction-type main hoist with a 1,600 horsepower, tower-mounted drum measuring 4.19 meters in diameter. Capacity is 14 tons through a maximum hoisting distance of 1,000 meters. Maximum speed is 10 meters per second, and the skip is in part counterbalanced with a 7-ton-capacity cage.

Estimates made by planners at Rubiales show that about 80% of the mine output can be extracted from open stopes. Stopes average 30 meters in width and are 70 meters high, alternating along the strike with 30-meter pillars. Stopes will be backfilled with tailings and sand, and later the pillars will be recovered. Atlas-Copco in-the-hole drills are used for drilling 6 1/2-inch holes that are blasted into slots, and ore is moved by load-haul-dump machines to passes leading to haulage levels. A Clayton locomotive, pulling a 13-car string of 10-ton, Granby-type cars, moves ore along a 1-kilometer-long haulage level.

In general, the roof is secured with resin-anchored roof bolts, and grouted anchor cables secure the back. Two 250,000-cubic-foot-per-minute exhaust fans blow air out of the mine through a 4.5-meter-diameter ventilation shaft which connects the main haulage level (597 level) with the surface. Downcast air enters the mine through the production shaft and the ramp.

The crystalline structure of the mineralization does not require fine grinding. However, the silica in the ore floats in the coarser grinds and is reground to be depressed in finer sizes.

Rubiales ore beneficiation starts with primary crushing underground which is completed in the surface plant. Sala rod and ball mills reduce the ore to 65% minus 200 mesh, and the pulp reaches the flotation circuits with 40% solids. The flotation section has 200-cubic-foot Denver cells in the roughing circuit, 100-cubic-foot cells in the zinc-cleaning circuit, and 50-cubic-foot cells in the lead-cleaning and recleaning circuits. Controls include high-level alarms on bins, a weightometer on feed to the rod mill (connected to a variable-speed feeder as a control on feed rate), and automation of makeup water feed to give constant density in the mill discharge. There are automatic samplers on plant feed, final lead concentrate, final zinc concentrate, and final tailings. Liquid-solid separation facilities and a zinc concentrate dryer are part of Rubiales' beneficiation installations. Mill water is close-circuited with no overflow from tailings. A concrete-faced rockfill dam is used to impound tailings and store process water. The Rubiales plant draws 12 to 18 liters per second of makeup water from a spring. Concentrate is loaded in 25-ton containers and trucked to the railroad point at Villafranca del Bierzo.

Expansion of the zinc smelter at San Juan de Nieva, owned by Soc. Minera y Metalúrgica de Peñarroya España S.A., was completed in 1977. The plant capacity has been increased to 205,000 tons of zinc per year.

During 1977, about one-half of the lead and zinc ore output was from northern Spain, and about one-third was from the District of Cartagena in southern Spain. The largest lead smelter was located near Santa Lucia, Cartagena, and was operated by Peñarroya. Asturiana de Zinc was the major producer of zinc in the country and operated the largest zinc plant in Spain at San Juan de Nieva.

Mercury.—Operating Almadén, the largest mercury mine in the world, Spain remained among the world's foremost mercury producers. Because of low prices of mercury, the Government, which operates Almadén, restricted sales to established customers. Production has not been affected by the low demand, and stockpiling continued.

Silicon.—A new facility for production of ferrosilicon went onstream in Huesca Province. The investor was Hidro Nitro Española S.A., which operates ferrosilicon-producing facilities with an annual capacity of 50,000 tons. Most of the new ferrosilicon production is slated for export.

NONMETALS

During 1977, Spain continued to produce a large variety of nonmetals. Potash, ocher, natural sodium sulfate, and celestite output were significant by European standards.

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However, the importance of production of all other nonmetals was limited to the domestic economy.

Cement.—As in the past, Spain was a net exporter of cement during 1977. Approximately 15% of its cement output is exported to various countries on the American and African continents. Annual production capacity of the cement industry was 34 million tons at yearend.

The largest producer was Cía. General de Asfaltos y Portland, Asland S.A., headquarterod in Barcelona. Asland owned about 14% of the total cement capacity of Spain. Although Asland was the largest cement producer in Spain, Uniland of Barcelona operated the country's largest cement plant, a 2-million-ton-per-year facility in Barcelona.

Dunite.—Dunite output reached an all-time high of about 700,000 tons in 1977. This level of production was reached in a period of 5 years. The largest producer was Pasek España S.A., a subsidiary of S.A. Pasek & Cie. of Belgium-Luxembourg. Pasek operates the David mine in the Sierra de la Capelada District of La Coruña Province in northwestern Spain. Pasek produced a total of 600,000 tons of product with an average chemical composition of 37% to 38% MgO, 38% to 39% SiO_2, and about 8% Fe_2O_3 (with a 10% loss on ignition). The product was crushed and ground at a facility near Landoy to produce three principal grades: 0 to 3 millimeters, 0 to 5 millimeters, and 10 to 40 millimeters. Most of Pasek's products were shipped to customers in northern Spain and France.

Located in the same area was the Herbeira mine, near Ortigueirra, operated by Bunitas Industriales. Its 1977 output of about 100,000 tons of dunite was used in ENSIDESA's works at Àviles. A third dunite operation, a small mine at Narón near El Ferrol in La Coruña Province, was operated by Rocas Arcillas y Minerales S.A.

A dunite deposit near Málaga in southern Spain was explored, and successful blast furnace tests were completed with ores mined at Rond-Morbella. The deposits were too far from European markets to be commercial, but they were thought to have potential for supplying future needs of the iron and steel industry in the Mediterranean area.

Fertilizer Materials.—*Nitrogenous.*—During 1977, Soc. Española de Fabricantes Nitrogenades' (Sefanitro) plan to construct a 270,000-ton-per-year ammonia plant at Castellón was scrapped because of environmental concerns expressed by the local government. A new 900-ton-per-day ammonia plant at Huelva, designed by Kellogg International Corp. and owned by ERT, started operating during the year.

Potash.—The potash industry in Spain was working to increase its annual production capacity from 740,000 tons in 1977 to 1,035,000 tons of K_2O equivalent by 1982. The following tabulation shows current and planned production capacities by mine, in thousand tons:

	1977	1982
Navarra (Navarra Province)	315	395
Suria (Barcelona Province)	145	190
Llobregat (Barcelona Province)	180	250
Cardona (Barcelona Province)	100	200

Potasas de Navarra continued development of new zones within its potash deposit near Pamplona, and Minas de Potasa de Suria continued work toward opening a new mine nearby.

Pigments, Mineral.—Construction continued on a 12,000-ton-per-year plant at Málaga for production of superfine and micronized grades of red oxide. The investor was Oxidos Rojos de Málaga S.A. Ocher mines are situated in the Provinces of Jáen and Granada. In addition, rod, black, and yellow oxides are produced in the Saragora area. Most of the 1977 oxides production was exported.

Pyrite.—Exploration of a pyrite deposit near Sotiel, Huelva Province, continued during 1977. Results of operation of the new pilot plant for beneficiation of Sotiel's ores were not made public during the year. Construction of a plant for recovery of base metals, iron, and sulfur from pyrite continued. The plant is located near Huelva, and output was reported as follows: 900,000 tons of iron pellets, 10,000 tons of copper concentrates, 8,000 tons of lead concentrates, and 32,000 tons of zinc concentrates.

The principal producers of pyrite in Spain were mines in southern Spain operated by Unión Explosivos Rio Tinto S.A. (ERT) and Cía. de Azufre y Cobre de Tharis.

Salt.—Rock salt, salt from brines, and marine salt were sources of supply during 1977. The output was approximately 50% higher than in the early 1970's, as a result of a substantial increase in the capacity of Union Salinera de España S.A.'s solar salt plant at Torrevieja (Alicante Province). This plant produced between 500,000 and 1

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million tons of salt by solar evaporation of seawater, from concentrated brine from the La Mata saline lagoon, and from saturated brine from the solution mining of a rock salt deposit at Pinoso, about 50 kilometers inland, which is pumped to the plant through a pipeline. The largest rock salt producer from salt mines was Solvay & Cie. of Belgium-Luxembourg, which operated mines at Torrevieja. Potasas de Navarra was the largest producer of byproduct salt from potash mining near Pamplona.

MINERAL FUELS

Petroleum, mostly imported, remained the principal source of energy in Spain. Coal was the principal mineral fuel produced in the country. Dependence on imported crude oil and other fuels was detrimental to Spain's balance of trade. Through the Second National Energy Plan, which was examined for submission to Parliament, the Government intended to lower consumption, reduce dependence on imports, diversify sources, and foster technological development in the energy industry. It also planned to establish new prices for energy products, support investments for improving certain industrial practices and equipment to curtail energy consumption or change the fuel used, and step up exploration, research, and participation in development of energy sources abroad to ensure sources of supply to meet the country's demand.

Table 5.—Spain: Supply and apparent consumption of fuels and power

(Million tons of standard coal equivalent[1])

	Total energy	Coal and coke	Petroleum and refinery products	Natural gas	Fuelwood	Hydroelectric and nuclear power
1975:						
Production	19.9	12.7	2.6	[2]	[2]	4.6
Imports	66.8	4.3	62.5	[2]	[2]	[2]
Exports	4.0	[2]	4.0	[2]	[2]	[2]
Apparent consumption	82.7	17.0	61.1	[2]	[2]	4.6
1976:						
Production	20.2	12.4	3.5	[2]	[2]	4.3
Imports	77.8	4.8	73.0	[2]	[2]	[2]
Exports	4.5	.1	4.4	[2]	[2]	[2]
Apparent consumption	93.5	17.1	72.1	[2]	[2]	4.3

[1] 1 ton standard coal equivalent (SCE) = 7 x 10^6 kilogram calories.
[2] Less than 0.01 million tons of standard coal equivalent.

Coal.—The expansion and renovation of existing coal mines continued. Higher coal output, planned to reach 34 million tons by 1980, remained the goal of Concerted Action Agreements between Government and industry. However, a new energy bill under discussion in Parliament may change output figures.

Development of the Meirama and Puentes de García Rodriguez lignite deposits, both in La Coruña Province, continued. The Meirama deposit, containing about 20 million tons of lignite with a calorific value of 2,000 kilocalories per kilogram, was to be developed as a 24-million-ton-per-year opencast mine. At the Puentes de García Rodriguez deposit, a 12.2-million-ton-per-year opencast mine was under development. Reserves on which the mine is based amount to 350 million tons of lignite having a calorific value of 1,800 kilocalories per kilogram.

During 1977, Spain produced anthracite, bituminous coal, and lignite. The Provinces of Oviedo and León were the largest producers of anthracite and bituminous coal. Most of the lignite was produced in the Provinces of Teruel, Barcelona, and La Coruña. Imports of coal, mostly coking coal, were an important part of the country's supply.

Petroleum and Natural Gas.—During 1977, Spain remained almost totally dependent on imported crude oil and natural gas to meet its demand. Domestic output of crude oil was modest, amounting to approximately 2% of petroleum refinery input of about 48 million tons. Petroleum refineries operated at about 80% of installed capacity in 1977.

Offshore exploration for crude oil and natural gas was intensive. The high cost of imported crude oil, which adversely affected the balance of trade, made domestic production, even at relatively high costs, more attractive than in the past. Exploration,

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both seismic and drilling, was conducted in the Mediterranean Sea and the Bay of Biscay. The most important result was discovery of oil by Chevron Oil Co. some 6 kilometers from the Casablanca IA production well in the Mediterranean Sea. The well, named Montanaza D-1, flowed during the test at a rate of about 9,504 barrels per day from depths of 2,592 to 2,612 meters. This new find indicated that the western part of the Mediterranean Sea may have some potential for oil production.

Ten petroleum refineries, with a combined installed annual capacity of 59.6 million tons, were in operation in 1977, distributed as follows in million tons:

Company	Location	Capacity
Empresa Nacional del Petróleo, S.A. (ENPETROL).	Escombreras	10
	Puertollano	6
	Tarragona	7
Cia. Ibérica Refinadora de Petróleos, S.A. (PETROLIBER).	La Coruña	5
Cia. Española de Petróleos, S.A. (CEPSA).	Santa Cruz de Tenerife.	8
	Algeciras	6.5
Petróleos del Mediterraneo, S.A. (PETROMED).	Castellón de la Plana.	4
Unión Explosivos Rio Tinto, S.A. (ERT).	Huelva	4
Refinería de Petróleos del Norte, S.A. (PETRONOR).	Somorrostro	8
Asfaltos Españoles S.A. (ASESA)	Tarragona	1.1

During 1977, several refineries were given permission to increase installed capacities. At the Somorrostro refinery, capacity is to be increased from 8 million tons to 12 million tons of crude oil per year by late 1978 or early 1979. The capacity of the petroleum refinery at Algeciras is to be increased to 8 million tons of crude oil per year.

The domestic output of natural gas was far below the country's demand. Foreign liquefied natural gas, supplied mostly by SONATRACH of Algeria, was the principal source of supply. To assure a continuous flow of gas to consumers in northern Spain, an 865-kilometer-long pipeline is being built in sections starting at Barcelona. Most advanced was the line from the regasification plant at Barcelona to Tarragona. It was hoped that natural gas would reach Tarragona sometime in 1978. The section from Castelnou to Mora de Ebro and Haro was progressing well. However, construction of the last 137 kilometers to Bilbao has been delayed by right-of-way litigations.

The idea of constructing a gas pipeline between Spain and Algeria was kept alive by studying possible routes for the line. At yearend, no firm decision had been made. Soc. de Estudios del Gasoducto Mediterráneo Occidental, formed in 1972 by SONATRACH (50%), Gaz de France (25%), and ENAGAS (25%), financed the studies during 1977.

Uranium.—Areas near Ciudad Rodrigo remained the principal territories for uranium exploration and production. Most active in the area was Empresa Nacional del Uranio S.A. Although construction of nuclear powerplants continued, the ambitious national plan for development of nuclear energy was under study for incorporation into the energy plan to be presented to Parliament. At yearend, three nuclear powerplants (1,120 megawatts electric) were in operation and five powerplants (6,555 megawatts electric) were under construction.

[1]Physical scientist, Branch of Foreign Data.
[2]Engineering and Mining Journal. V. 178, No. 4, April 1977.

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The Mineral Industry of Sudan

By Candice Stevens[1]

The mineral industry of Sudan made a minor contribution to the gross national product (GNP) of approximately $4.3 billion[2] in 1977. However, the new 6-year development plan (1977-82) was to provide the foundation for the exploitation of Sudan's promising mineral potential. Approximately 25% of the total expenditure of $6.5 billion was to be allocated to the mining and manufacturing sector. Major goals were intensification of mineral exploration, promotion of private investment, and development of basic infrastructure. Projects included a major increase in cement capacity, further development of chromite, gold, and mica mining, and construction of a fertilizer complex and a petroleum refinery. Occurrences of copper, asbestos, manganese, uranium, and lead-zinc were to be further evaluated as were indications of oil and gas.

The Sudanese Government initiated an economic stabilization program designed to reduce the inflation rate, decrease the serious balance-of-payment deficit, and promote greater financial discipline. In 1977, Sudan was attempting to reschedule payment of its foreign debts, estimated to total $1.5 billion. Sudan received a loan of $62.8 million from the International Monetary Fund on the basis of the country's new fiscal and monetary policies.

Sudan actively sought investment from other countries under the Development and Promotion of Industrial Investment Act. This legislation included 3- to 10-year tax holidays for foreign investors, exemption from customs and other duties, full repatriation of profits in case of liquidation, and safeguards against arbitrary confiscation and nationalization. Earlier provisions placing restrictions on mineral prospectors were removed in 1977, and a new mining and investment code was under consideration. The Sudanese-American Council for Cooperation, established in 1976 after the United States and Sudan resumed diplomatic ties, was responsible for aiding investors and promoting closer economic ties between the two countries.

A major focus of investment was the development of Sudan's infrastructure. A $64 million project, funded largely by the International Bank for Reconstruction and Development (IBRD), was to modernize and expand facilities at Port Sudan. Work was to include the mechanization of cargo handling and was to result in increased physical capacity and operational productivity, and improved management capability by 1981. Construction continued on the 750-kilometer all-weather road linking Port Sudan and Khartoum. Cofinanced by the Sudanese Government and the Saudi Arabian Development Fund, the road was to be opened in 1978. Norway agreed to finance a feasibility study for a 230-kilometer road linking Kitale in Kenya to Juba in southern Sudan. This road would give southern Sudan direct access to the Kenyan port of Mombasa and provide an alternative transport route. A long-term plan to overhaul and modernize Sudan's 3,500-kilometer narrow-gage railroad was in progress.

PRODUCTION AND TRADE

Chromite and refined petroleum products remained Sudan's most important mineral commodities. Manganese, gold, and mica were mined on a small scale. Cement pro-

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duction was based on local gypsum deposits, and salt was produced largely for export. The production of minerals in Sudan is given in table 1.

Sudan continued to evidence a balance-of-trade deficit of approximately $400 million in 1977, owing to increased outlays for food and petroleum imports. Chrome was exported primarily to Japan, Switzerland, and the People's Republic of China. Exports of chrome, salt, and refined petroleum products contributed about 6% of the total export value. Refined petroleum products were imported from Kuwait, and fertilizer was imported under a long-term supply agreement with Kuwait Chemical Fertilizer Co. Approximately 8 million barrels of crude oil for refining were imported under a 5-year contract with Iraq. Under new supply agreements concluded in 1977, crude oil was to be imported from Saudi Arabia, Egypt, and the United Arab Emirates in future years.

Table 1.—Sudan: Production of mineral commodities

Commodity[1] and unit of measure	1975	1976	1977[p]
Cement, hydraulic thousand metric tons	216	130	137
Chromium: Chromite concentrate, gross weight metric tons	15,000	21,000	17,273
Gold, mine output, metal content[e] troy ounces	300	300	300
Gypsum and anhydrite, crude[e] metric tons	[r]30,000	18,000	4,140
Magnesite, crude[e] do.	100	100	--
Manganese ore do.	--	458	457
Mica, all grades do.	[e]250	550	[e]400
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	971	1,022	1,170
Jet fuel do.	368	390	275
Kerosine do.	277	285	267
Distillate fuel oil do.	3,232	2,348	2,440
Residual fuel oil do.	2,538	3,174	3,347
Other do.	404	135	42
Refinery fuel and losses do.	531	640	362
Total do.	8,321	7,994	7,903
Salt metric tons	66,000	70,000	91,713

[e]Estimate. [p]Preliminary. [r]Revised.

[1]In addition to the commodities listed, modest quantities of a variety of crude construction materials (including clays, stone, and sand and gravel) presumably were also produced, but output is not reported quantitatively and available information is inadequate to make reliable estimates of output levels.

Table 2.—Sudan: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1976
Copper metal scrap	188
Iron and steel metal scrap	450
Lead metal scrap	598
Ores and concentrates of base metals	26,080
Salt	1,288
Sodium carbonate, natural	1,980
Petroleum refinery products: Residual fuel oil	1,332

Sources: Democratic Republic of the Sudan, Foreign Trade Statistics, 1976. U.S. Department of Energy, International Petroleum Annual, 1976.

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Table 3.—Sudan: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1976
METALS		
Aluminum:		
Oxide and hydroxide		174
Metal including alloys, unwrought and semimanufactures		883
Copper metal including alloys, unwrought and semimanufactures		171
Iron and steel metal:		
Pig iron, ferroalloys, similar materials		106
Steel, primary forms		35
Semimanufactures:		
Bars, rods, angles, shapes, sections		22,594
Universals, plates, sheets		24,117
Hoop and strip		2,334
Rails and accessories		656
Wire		544
Tubes, pipes, fittings		13,588
Castings and forgings, rough		132
Lead metal including alloys, unwrought and semimanufactures		685
Tin metal including alloys, unwrought and semimanufactures		13
Zinc metal including alloys, unwrought and semimanufactures		910
Other:		
Oxides, hydroxides, and peroxides of metals, n.e.s		68
Base metals including alloys, all forms, n.e.s		127
Oxides of zinc and lead, not separated		281
Oxides of manganese, iron, cobalt, and titanium, not separated		444
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, etc		40
Dust and powder of precious and semiprecious stones		2
Grinding and polishing wheels and stones		50
Asbestos		150
Cement		65,245
Clays and clay products (including all refractory brick):		
Crude		192
Products:		
Refractory (including nonclay brick)		686
Nonrefractory		452
Fertilizer materials:		
Manufactured:		
Nitrogenous		206,728
Phosphatic		25
Ammonia		73
Graphite, natural	value	$301
Gypsum and plaster		1
Lime		135
Pigments, mineral, natural		54,600
Sodium and potassium compounds:		
Caustic soda		8,719
Caustic potash and sodic and potassic peroxides		28
Stone, sand and gravel:		
Dimension stone		195
Sand, excluding metal bearing		3
Sulfur:		
Elemental, all forms		17
Sulfuric acid		613
Other:		
Crude		98
Bromine, chlorine, fluorine		10
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s		5,459
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural		4,867
Carbon black		1
Oxygen, nitrogen, hydrogen, rare gases		17
Petroleum refinery products:		
Gasoline:		
Motor	thousand 42-gallon barrels	22
Aviation	do.	100
Kerosine	do.	31
Distillate fuel oil	do.	566
Lubricants	do.	146
Other:		
Liquefied petroleum gas	do.	69
Mineral jelly and wax	do.	1
Bituminous mixtures, n.e.s	do.	94
Total	do.	1,029
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		2

Source: Democratic Republic of Sudan, Foreign Trade Statistics, 1976.

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COMMODITY REVIEW

METALS

Several foreign interests were involved in mineral surveys, mapping, and exploration under the auspices of the Geological and Minerals Resources Department (GMRD). Hunting Geology and Geophysics Ltd. (United Kingdom) continued its general mineral survey in southern Sudan. The focus was on metals and industrial minerals such as limestone, asbestos, clay, and talc. Under a protocol signed in 1976, the U.S.S.R. conducted gravimetric and magnetic surveys in 75,000 square kilometers on the Red Sea coast. Manganese and iron deposits along the coast were to be evaluated in a 2-year period.

The Bureau de Recherches Géologiques et Minières (BRGM) of France began a 3-year assessment of the mineral resources of the Red Sea coastal area. France would bear all costs of this project, which is to assess the commercial potential of gold, chrome, iron, and magnesium deposits. The Federal Republic of Germany continued its mapping and prospecting program for base metals in a 40,000-square-kilometer area of the Bayuda Desert. The United Nations Revolving Fund for Natural Resource Exploration was conducting feasibility studies of iron ore and manganese deposits in the Red Sea coastal area and copper deposits at Hofrat en Nahas.

The Saudi-Sudanese Commission for the Exploitation of Red Sea Resources planned to spend $17 million in 1978 on experimental dredging of Red Sea sediments. Sampling indicated approximately 50 million tons of metalliferous bottom sediments including zinc, copper, and silver. Preussag A.G. (Federal Republic of Germany) was to conduct overall feasibility studies on seabed mineral exploitation. The BRGM was to act as technical consultant to the project.

Chromite.—Chromite production in the Ingessana Hills in southeastern Blue Nile Province was approximately 17,000 tons in 1977. The Government-owned Ingessana Hills Mines Corp. had a capacity of 15,000 to 20,000 tons per year in underground workings. The State planned to invest $2.5 million to double annual output by 1978. Privately owned Blue Nile Chromium Ltd. had a capacity of 5,000 tons per year in small opencast workings.

In 1977, Mitsubishi Corp., in partnership with Japan Metals & Chemicals Co. Ltd., began a $1 million feasibility study of the development of additional chromite reserves in the Ingessana Hills area. Earlier drilling by the Japanese indicated large reserves grading 35% to 40% chrome. A potential joint venture to mine 200,000 tons per year of chrome would be owned 51% by Sudan and 49% by the Japanese companies. The Japanese would have the right to 49% of production and first option to the remainder. A further element of the contract was the possible construction of a ferrochrome industry in Sudan.

Gold.—Gold mined at the Gebeit mine in the Red Sea Hills and from smaller alluvial deposits totaled about 300 troy ounces per year. There were over 75 known gold occurrences in Sudan, primarily in the northeast. The last of the producing gold mines closed down regular production in 1974, and gold was mined largely by primitive means by local natives. The possibility of reopening the gold workings in the Serakoit region was under study by the British firm Robertson Research International Ltd.

Iron Ore.—Feasibility studies were being conducted of Sudan's two main iron ore deposits. The Fodikwan deposit, located north of Port Sudan, was estimated to contain 50 million to 100 million tons of ore with an average iron content of 35% to 40%. The Sufaya deposit, located in the northern Red Sea Hills, was estimated to contain 6 million tons of ore averaging 60% to 63% iron. Iron has been mined in this area by individual workers for many centuries.

Manganese.—Manganese was produced on a small scale in the Red Sea Hills and coastal area. Approximately 28 manganese occurrences have been identified in Sudan, with manganese contents between 47% and 55%. Studies were in progress to determine if some of these occurrences would support large-scale development. In 1977, production was approximately 460 tons of ore averaging 48% manganese.

Uranium.—Three firms were actively involved in uranium exploration in Sudan in 1977. Agip S.p.A. was reported to have located deposits near Hofrat en Nahas containing 10 million tons of copper and uranium ore. No grade was reported. Wyoming Mineral Corp., a subsidiary of Westinghouse Electric Corp. (United States), was exploring for uranium in a 290,000-square-kilometer concession area in Darfur and

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Northern Provinces. Essex Minerals Co., a subsidiary of United States Steel Corp., was also engaged in uranium prospecting under a 1976 contract.

NONMETALS

Asbestos.—Johns-Manville Corp. (United States), in conjunction with Gulf International Co., began drilling for asbestos in the Qala en Nahl area near the Ethiopian border. Reserves of chrysotile-type asbestos in serpentine rocks were estimated at 20 million tons of ore averaging 5% asbestos. Johns-Manville held a 10,000-square-kilometer concession area in Blue Nile and Kassala Provinces. A $3.6 million feasibility study for a plant to produce 100,000 tons of asbestos fiber per year was planned.

Cement.—Cement production was approximately 137,000 tons in 1977 as Sudan continued to rely heavily on imported cement. Maspion Cement Corp., located at Atbara in Northern Province, was to undergo an increase in capacity from 225,000 tons to 500,000 tons per year. Increased capacity was also planned for Nile Cement Co. at Rabak from 60,000 tons to 100,000 tons per year. Work began on the Red Sea Cement Co. plant at Derudeb, which was to produce 500,000 tons per year of cement by 1980.

Fertilizer Materials.—Construction of Sudan's first ammonia-urea complex, announced in 1973 but delayed by financing problems, was to begin in 1978. The $125 million plant was a joint venture of the Sudanese Government (65%) and N-Ren International (35%). Located 11 kilometers south of Khartoum, the Sudan-Ren Chemicals and Fertilizer Co. plant was to have a capacity of 200 tons per day of ammonia and 300 tons per day of urea. Construction by Vöest-Alpine AG (Austria) was to be financed by loans from Austria, Canada, and the Federal Republic of Germany. Naphtha for feedstock would be transported from the Port Sudan refinery by the new Port Sudan-Khartoum pipeline. Fertilizer production would serve the main consumption area around the Gezira agricultural project and the Kenana sugar scheme.

Mica.—About 400 tons of mica was produced from pegmatites in the eastern Bayuda Desert in the vicinity of Shereik. With the support of the United Nations Minerals Project, a small-scale operation was established in 1974 to develop the mica deposits. Construction of a plant to dry-grind mica scrap was under construction.

MINERAL FUELS

Petroleum.—The Port Sudan refinery, owned 50% by the Sudanese Government and 50% by Royal Dutch/Shell and British Petroleum Co. Ltd., produced about 8 million barrels of petroleum products in 1977. A second refinery was under construction at Port Sudan as a joint venture between the Sudan Government and the Saudi firm Triad Naft Co. Ltd. The cost of this 200,000-barrel-per-day refinery was estimated at $250 million.

In December, the 815-kilometer pipeline linking Port Sudan and Khartoum was officially commissioned. Financed by a $75 million loan from Kuwait, the pipeline was to carry petroleum products to the interior and would free fuel-carrying rolling stock on the Port Sudan-to-Khartoum railway. Initial capacity of the pipeline was to be 600,000 tons per year, later to be expanded to 850,000 tons per year.

Chevron Overseas Petroleum Inc., a subsidiary of Standard Oil Co. of California, expanded its petroleum exploration efforts in Sudan. In partnership with Texaco Sudan Inc., Chevron made two gas discoveries at Suakin and Bashayer on the Red Sea coast near Port Sudan. Reserves were estimated at 130 billion cubic feet of gas at Suakin and 48 billion cubic feet at Bashayer.

Chevron also made an oil discovery near Bentiu in its 516,000-square-kilometer concession area in south-central Sudan. Drilling was to continue in the area in 1978. Chevron's petroleum exploration license was transformed into a production-sharing contract in 1976 that provided for the Sudanese Government to acquire 70% to 75% of any exploitation venture.

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[1]Economist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Sudanese pounds (£Sd) to U.S. dollars at the rate of £Sd1 = US$2.50.

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The Mineral Industry of Sweden

By Joseph B. Huvos[1]

The mineral industry of Sweden is small but technologically advanced. The country is one of the world's largest iron ore producers, and there is significant production of nonferrous metals. Fossil fuels are imported.

Indices of Swedish mineral industry production (1968=100) in 1976 and 1977 are shown in the following tabulation:

Industry sector	1976[r]	1977[p]
Iron ore mining	113	93
Nonmetallic mineral products	92	93
Base metal industries	121	108
Mining, quarrying, manufacturing	130	127

[p]Preliminary. [r]Revised.

Source: Monthly Digest of Swedish Statistics. No. 3, 1978, p. 13.

In 1977, the Swedish economy suffered from weak foreign demand (mainly for investment goods) and another sizable increase in unit labor costs, which was not alleviated by two devaluations of the Swedish krona. Sweden's gross national product (GNP) in 1977 was about $73 billion.[2 3] The current foreign trade deficit was $7.9 billion. Unemployment was maintained by subsidies at under 2% of the work force.

Significant developments in Sweden's mineral industry in 1977 included reorganization of its steel industry with the formation of Svenskt Staal AB (SSAB); continuation of development work at Soc. des Mines et Fonderies de Zinc de la Vieille-Montagne's Zinkgruvan mine, A/B Statsgruvor's tungsten mine, and the Svappavaara iron ore concentrator; allocation of funds for development of Luosavaara-Kiirunavaara AB's (LKAB) copper deposit at Viscaria and its Kiirunavaara apatite-processing plant; and closure of Boliden AB's Adak copper mine and Ställberg Grufveaktieblag's three iron ore mines.

PRODUCTION

In 1977, many minerals were produced at a low level. Production of mineral commodities for 1975-77 is shown in table 1.

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Table 1.—Sweden: Production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity[1]		1975	1976	1977[p]
METALS				
Aluminum, unalloyed:				
Primary	tons	76,787	82,517	82,216
Secondary	do.	606	--	381
Arsenic:				
White, refined	do.	10,500	5,800	5,300
Metallic	do.	900	1,100	700
Bismuth, mine output, metal content[e]	do.	15	15	15
Copper:				
Mine output, metal content	do.	40,634	44,860	44,764
Metal:				
Unrefined	do.	807	2,561	--
Refined:				
Primary	do.	49,468	55,566	47,684
Secondary	do.	6,753	7,301	14,036
Total	do.	56,221	62,867	61,720
Gold:				
Mine output, metal content	troy ounces	63,176	62,179	67,984
Metal including alloys	do.	109,923	147,700	136,705
Iron and steel:				
Iron ore and concentrate, gross weight:				
Direct-shipping ore		18,847	17,126	12,845
Concentrate		12,020	12,736	11,994
Total		30,867	29,862	24,839
Metal:				
Pig iron and sponge iron[2]		3,484	3,140	2,491
Electric-furnace ferroalloys:				
Silicomanganese	tons	8,558	7,461	--
Ferrosilicon	do.	50,219	36,726	22,282
Ferrochromium	do.	92,358	116,486	134,452
Ferrochromium-silicon	do.	15,513	5,877	8,456
Ferrotungsten	do.	722	422	487
Ferromolybdenum	do.	1,659	1,830	1,003
Ferrovanadium	do.	407	575	423
Crude steel		5,611	5,140	3,968
Semimanufactures:				
Bars, rods, sections		1,494	1,364	1,210
Plates and sheets		1,927	1,753	1,345
Strip		115	120	87
Rails and accessories		57	66	56
Pipe and tube stock		253	227	207
Other, including forgings and castings		280	292	349
Total		4,126	3,822	3,254
Lead:				
Mine output, metal content	tons	70,383	81,625	88,132
Metal, refined:				
Primary	do.	38,342	49,068	51,950
Secondary	do.	331	337	80
Nickel metal, unalloyed	do.	3,045	3,377	e3,400
Selenium, elemental (refined)	do.	67	60	66
Silicon metal	do.	16,463	17,968	e18,000
Silver:				
Mine output, metal content	thousand troy ounces	4,515	4,617	5,438
Metal including alloys	do.	7,034	6,363	6,810
Tungsten, mine output, metal content	tons	143	194	199
Uranium oxide (U_3O_8)[e]	do.	70	70	80
Zinc:				
Mine output, metal content	do.	111,325	128,326	140,233
Clinker (70%-75% Zn)	do.	25,200	26,100	28,200
NONMETALS				
Cement, hydraulic[3]		3,406	2,869	e2,580
Chalk	tons	33,945	37,529	36,205
Clays, refractory		187	180	NA
Diatomite, calcined	tons	423	327	--
Feldspar, salable, crude and ground	do.	44,742	44,746	52,167
Fertilizer materials, manufactured:				
Nitrogenous		r593	533	NA
Phosphatic:				
Thomas slag, gross weight		r196	205	NA
Other		372	398	NA
Mixed and other		r953	912	NA

See footnotes at end of table.

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Table 1.—Sweden: Production of mineral commodities —Continued

(Thousand metric tons unless otherwise specified)

Commodity[1]		1975	1976	1977[p]
NONMETALS —Continued				
Fluorspar	tons	3,405	3,324	2,414
Gypsum, manufactured	do.	89,900	142,800	211,100
Lime (quicklime, hydrated lime, dead-burned dolomite)		927	857	769
Pigments, mineral, natural	tons	1,440	1,009	975
Pyrite and pyrrhotite (including cuprous), gross weight		414	404	402
Stone, sand and gravel:				
Dimension stone:				
Unworked:				
Limestone and marble		36	34	28
Granite and gneiss		64	62	65
Quartz		41	29	20
Quartzite		22	23	3
Micaceous schist		18	19	20
Sandstone		38	31	33
Other		32	26	15
Worked, all types[4]		92	86	68
Crushed, broken, and other stone:				
Clay slate		68	47	54
Dolomite:				
Crude		405	370	360
Burnt		32	40	25
Granite and gneiss		7,696	7,826	8,032
Limestone:				
For cement		4,336	3,479	3,066
For lime		1,050	881	752
For other industrial uses (including lime marl)		r2,248	2,182	2,268
Micaceous schist		17	--	--
Quartz		18	17	15
Quartzite		1,933	1,795	1,597
Sandstone		290	260	275
Other		1,064	906	1,036
Sulfur:				
Content of pyrite		211	205	204
Byproduct:				
From metallurgy		130	r e140	e135
From other sources		13	28	e30
Total		r354	r e373	e369
Talc and steatite	tons	23,864	20,442	21,214
Other, crude[5]	do.	NA	5,873	3,104
MINERAL FUELS AND RELATED MATERIALS				
Carbon black	do.	24,576	22,992	e20,000
Coal, all grades		10	9	2
Coke, metallurgical		829	1,078	918
Oil shale:				
For fuel production use		88	30	12
For other use		10	11	6
Peat:				
For agricultural use		77	89	92
For fuel use		34	32	30
Petroleum refinery products:				
Gasoline	thousand 42-gallon barrels	12,989	20,893	21,083
Kerosine	do.	--	39	63
Jet fuel	do.	1,013	656	1,094
Distillate fuel oil	do.	26,700	34,555	37,556
Residual fuel oil	do.	33,664	38,908	39,846
Lubricants	do.	294	210	e300
Other:				
Naphtha	do.	491	383	195
White spirit	do.	101	1,717	2,597
Unspecified	do.	3,868	5,320	NA
Refinery fuel and losses	do.	2,850	6,795	6,771
Total	do.	81,970	109,476	109,505

e Estimate. p Preliminary. r Revised. NA Not available.

[1] In addition to the commodities listed, cobalt, nickel (as nickel sulfate), and metallic titanium are also produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2] Includes sponge iron as follows, in thousand tons: 1975—175, 1976—188, and 1977—161.

[3] Includes clinker as follows, in thousand tons: 1975—243, 1976—116, and 1977—e50.

[4] Represents material for sale, not that produced.

[5] Includes strontium minerals, unspecified minerals, and fragments of ceramic materials.

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TRADE

There was no major change during 1977 in Sweden's mineral trade pattern; Scandinavian and Western European countries remained as its primary trading partners. The principal commodities exported were iron and steel, iron ore, and nonferrous metals. Sweden's mineral commodity trade in 1975 and 1976 is shown in tables 2 and 3.

Major mineral imports from the United States were coal, iron and steel semimanufactures, nonferrous metals, and fertilizers. Mineral exports to the United States included mainly nonferrous ores and metals and iron and steel semimanufactures. United States-Swedish trade in 1976 is shown in table 4.

Table 2.—Sweden: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Bauxite and concentrate	750	1,150	Norway 852; Finland 298.
Alumina	19	4	NA.
Metal including alloys:			
Scrap	1,250	1,897	West Germany 1,112; Denmark 321; France 200.
Unwrought	8,019	13,337	Norway 7,672; West Germany 1,572; Japan 1,396.
Semimanufactures	31,955	45,350	Denmark 8,922; United Kingdom 6,798.
Arsenic oxide and acids value, thousands	$3,059	$1,053	NA.
Chromium ore and concentrate	--	42	All to West Germany.
Copper:			
Ore and concentrate	9,820	32,064	East Germany 21,248; Bulgaria 10,766.
Metal including alloys:			
Scrap	932	1,053	France 409; West Germany 327; Finland 198.
Unwrought	22,202	36,269	United Kingdom 10,348; West Germany 8,868; Finland 5,388.
Semimanufactures	46,308	47,030	United States 8,882; Norway 8,861; Denmark 8,825.
Iron and steel:			
Ore and concentrate, except roasted pyrite thousand tons	23,081	22,030	West Germany 5,288; United Kingdom 4,516; Belgium-Luxembourg 4,504.
Roasted pyrite do	430	388	United Kingdom 198; West Germany 121; Belgium-Luxembourg 41.
Metal:			
Scrap do	11	9	West Germany 5; Denmark 2; Belgium-Luxembourg 1.
Pig iron, including cast iron do	283	158	Poland 46; West Germany 14; Italy 14; United Kingdom 14.
Ferroalloys do	67	83	United Kingdom 44; West Germany 11.
Steel, primary forms do	120	165	West Germany 51; Finland 47; United States 32.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	457	264	Denmark 51; United Kingdom 45; Finland 38; Norway 32.
Universals, plates, sheets do	737	653	West Germany 131; United Kingdom 106; Denmark 104.
Hoop and strip do	69	74	Denmark 12; West Germany 10; United States 7.
Rails and accessories do	25	19	Norway 7; East Germany 5; West Germany 2.
Wire do	58	69	West Germany 11; United States 11; United Kingdom 6.
Tubes, pipes, fittings do	200	23	West Germany 4; Norway 3; Denmark 2.
Castings and forgings, rough do	3	27	Norway 7; Denmark 5; Finland 3.
Lead:			
Ore and concentrate	49,520	61,036	West Germany 52,829.
Oxide	293	245	NA.
Metal including alloys, all forms	28,188	39,492	West Germany 22,806.
Magnesium metal including alloys:			
Scrap	299	301	United States 130; West Germany 71; Netherlands 65.
Unwrought and semimanufactures	--	5	Denmark 2; West Germany 1.
Mercury 76-pound flasks	145	464	United States 319; Norway 145.
Molybdenum ore and concentrate	884	730	United Kingdom 313; West Germany 156; Finland 82.

See footnotes at end of table.

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Table 2.—Sweden: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Nickel:			
Matte	--	51	All to Finland.
Metal including alloys:			
Scrap	714	845	West Germany 262; Finland 241; India 145.
Unwrought	2,902	2,382	Netherlands 2,268.
Semimanufactures	2,100	1,731	France 178; Netherlands 174; Poland 174.
Platinum-group metals and silver:			
Waste and sweepings value, thousands	$8,435	$8,072	United Kingdom $2,586; West Germany $2,346; Norway $1,523.
Metals including alloys, unworked or partly worked:			
Platinum-group do	$642	$724	Finland $429; Denmark $216.
Silver do	[1]$36,051	$23,735	NA.
Silicon, elemental	9,587	12,141	West Germany 2,648; East Germany 2,292; United Kingdom 1,939.
Tin metal including alloys:			
Scrap	14	17	All to Norway.
Unwrought and semimanufactures	83	63	Finland 34; West Germany 21.
Titanium:			
Ore and concentrate	--	14	All to Turkey.
Oxide	76	40	Norway 36.
Tungsten:			
Ore and concentrate	--	135	Netherlands 74; United Kingdom 39; West Germany 21.
Metal including alloys, all forms	101	110	West Germany 70; Austria 14; United Kingdom 14.
Zinc:			
Ore and concentrate	210,112	253,367	West Germany 74,392; Norway 57,988; Belgium-Luxembourg 49,165.
Oxide and peroxide	520	672	United Kingdom 406; Norway 170.
Metal including alloys:			
Powder	75	103	Norway 36; Belgium-Luxembourg 34; Denmark 10.
Scrap	511	3,527	Norway 1,886; United Kingdom 595; West Germany 335.
Unwrought and semimanufactures	582	741	Finland 159; Spain 39; Denmark 37.
Zirconium ore and concentrate	14	--	
Other:			
Ores and concentrates	466	2,689	Mainly to Norway.
Ash and residue containing nonferrous metals	33,663	53,757	Norway 25,776; United States 23,020.
Metals including alloys, all forms	1,296	1,693	NA.
Oxides, hydroxides, peroxides of metals	[r]22	105	United Kingdom 78.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	9	18	Belgium-Luxembourg 9; Norway 7.
Dust and powder of precious and semiprecious stones value, thousands	$30	$15	Belgium-Luxembourg $7; Finland $6.
Grinding and polishing wheels and stones	2,413	2,371	West Germany 513; Finland 274; Denmark 254.
Asbestos	173	119	West Germany 87; Finland 11.
Cement, hydraulic	337,282	107,619	NA.
Chalk	7,446	9,875	Denmark 3,618; Norway 2,916.
Clays and clay products (including all refractory brick):			
Crude	966	1,236	Norway 776; Denmark 205; Finland 178.
Products:			
Refractory (including nonclay brick)	29,496	26,303	Norway 8,096; Finland 6,280; Denmark 5,368.
Nonrefractory	26,916	25,670	Norway 7,789; Denmark 5,752; Belgium-Luxembourg 3,219.
Diamond:			
Gem, not set or strung value, thousands	$648	$597	Belgium-Luxembourg $236; Norway $116; Denmark $85.
Industrial do	$117	$706	Netherlands $222; Norway $117; Japan $72.
Diatomite and other infusorial earth	124	195	Norway 65; Finland 37; Italy 30.
Feldspar, fluorspar, etc	32,157	30,757	United Kingdom 16,963.
Fertilizer materials:			
Crude:			
Nitrogenous	568	487	All to Norway.
Phosphatic	23,617	13,868	Mainly to Norway.
Manufactured:			
Nitrogenous	56,220	34,469	Belgium-Luxembourg 20,532; East Germany 5,118; Finland 3,814.
Phosphatic	59,287	97,067	Norway 5,772.
Potassic	1,803	1,249	NA.
Other, including mixed	7,358	13,668	Norway 5,175.

See footnotes at end of table.

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Table 2.—Sweden: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Graphite, natural	73	97	All to West Germany.
Gypsum and plaster	138	21	NA.
Lime	584	727	Norway 616.
Magnesite	84	64	Norway 25; Denmark 19; Finland 15.
Mica, including splittings and waste	13	17	Finland 10; Norway 3.
Pigments, mineral:			
Natural, crude	9	4	NA.
Iron oxide	76	44	Finland 20; Belgium-Luxembourg 12; Denmark 10.
Salt and brine	261	5,837	Denmark 5,628.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Marble and other calcareous	2,324	3,721	Denmark 2,429.
Slate	11,614	12,759	Belgium-Luxembourg 5,756; Norway 4,436.
Other, including granite, gneiss, etc	74,517	158,892	Denmark 83,809; West Germany 23,364; Italy 21,872.
Worked	15,066	15,540	Denmark 10,688; Norway 2,085.
Dolomite, chiefly refractory grade	3,424	4,921	Norway 1,981; Finland 977.
Gravel and crushed rock thousand tons	1,551	1,461	Denmark 677; West Germany 677.
Limestone (except dimension)	738,944	801,396	Finland 452,704; West Germany 237,212; Denmark 109,577.
Quartz and quartzite	91,928	89,304	Norway 45,016; West Germany 24,845.
Sand, excluding metal bearing	87,799	56,422	Norway 46,571; Denmark 7,218.
Sulfur:			
Elemental, all forms	NA	19,394	Netherlands 16,861; West Germany 2,533.
Sulfuric acid	69,730	24,533	Netherlands 12,139; United Kingdom 10,156.
Sulfur dioxide	11,360	13,204	Norway 12,595.
Talc, steatite, soapstone, pyrophyllite	4,110	4,275	United Kingdom 3,307; Denmark 450.
Other:			
Crude	9,870	14,742	Denmark 5,015; United Kingdom 4,185; Norway 3,903.
Slag, dross, and similar waste, not metal bearing	122,927	75,715	Norway 29,993; East Germany 19,428; United Kingdom 17,273.
Oxides and hydroxides of magnesium, strontium, barium	53	109	Norway 24; Denmark 22; West Germany 20.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt, natural	20	5	NA.
Carbon black	6,822	7,061	Norway 2,859; Finland 2,269; Denmark 1,070.
Coal and coke, including briquets	51,354	5,931	Netherlands 5,596.
Coke and semicoke	17,665	74,182	Finland 49,764; Venezuela 20,024.
Hydrogen, nitrogen, rare gases	2,848	4,059	Denmark 3,160; Finland 842.
Peat, including peat briquets and litter	18,250	21,347	Denmark 11,932; Norway 7,771.
Petroleum refinery products:			
Gasoline, aviation and motor thousand 42-gallon barrels	1,413	2,091	Norway 1,081; Denmark 911.
Kerosine and jet fuel do	347	119	Norway 67; Finland 52.
Distillate fuel oil do	3,466	2,981	Denmark 1,806; Norway 802; West Germany 301.
Residual fuel oil do	5,403	7,369	Denmark 6,345; Norway 403; United Kingdom 391.
Lubricants do	452	414	Norway 160; Denmark 84; Finland 78.
Other:			
Liquefied petroleum gas do	153	247	Denmark 161; Norway 70.
Naphtha do	NA	243	United Kingdom 190.
Mineral jelly and wax do	NA	1	Mainly to Norway.
Petroleum coke, asphalt, bitumen do	249	181	Denmark 107; Norway 33.
Unspecified do	149	47	Mainly to Denmark.
Total do	11,632	13,693	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	18,019	187,896	Norway 54,427; Denmark 49,993; West Germany 35,664.

[r]Revised. NA Not available.

[1]Quantity reported as 8,198,000 troy ounces.

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Table 3.—Sweden: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite and concentrate	68,042	38,523	Australia 16,397; Guyana 12,007; Greece 4,872.
Alumina	220,221	189,849	Jamaica 129,273; West Germany 30,395.
Metal including alloys:			
Scrap	1,140	1,179	Poland 741; Norway 143.
Unwrought	43,772	46,766	Norway 27,156; Ghana 6,892.
Semimanufactures	48,546	58,557	Norway 15,507; Austria 6,462.
Chromium:			
Chromite	395,735	377,465	Finland 128,949; U.S.S.R. 127,120; Philippines 40,179.
Oxide and hydroxide	2,250	840	West Germany 394; U.S.S.R. 91.
Copper:			
Ore and concentrate	56,387	57,946	Norway 19,067; Canada 14,376; Philippines 11,271.
Matte	6,685	8,643	Mainly from France.
Metal including alloys:			
Scrap	8,485	3,189	France 1,123; United States 457; Finland 414.
Unwrought	75,003	69,534	Zambia 15,880; Belgium-Luxembourg 12,173; Canada 11,476.
Semimanufactures	28,461	32,696	United Kingdom 9,805; West Germany 7,410; Finland 5,984.
Iron and steel:			
Ore and concentrate, except roasted pyrite	319,000	189,000	Mainly from Liberia.
Metal:			
Scrap	338,144	137,046	U.S.S.R. 71,339; West Germany 14,762; Denmark 13,942.
Pig iron, including cast iron	223,820	235,380	East Germany 50,362; Finland 39,559; India 37,106.
Ferroalloys	185,590	175,948	Norway 75,126; Republic of South Africa 23,190.
Steel, primary forms	216,602	464,395	Finland 165,923; West Germany 94,859.
Semimanufactures:			
Bars, rods, angles, shapes, sections	783,618	415,215	West Germany 85,869; Belgium-Luxembourg 69,284; France 55,331.
Universals, plates, sheets	1,039,392	1,161,306	Japan 267,621; West Germany 192,264.
Hoop and strip	102,585	124,943	Poland 36,682; West Germany 21,072.
Rails and accessories	5,140	3,924	West Germany 2,613; United Kingdom 976.
Wire	106,394	24,549	Belgium-Luxembourg 5,492; United Kindgdom 5,087; Austria 4,677.
Tubes, pipes, fittings	33,134	41,409	West Germany 16,973; United Kingdom 7,814; France 6,804.
Castings and forgings, rough	13,690	41,194	Poland 10,694; West Germany 6,218.
Total	2,083,953	1,812,540	
Lead:			
Oxide	2,917	3,112	West Germany 1,394; United Kingdom 1,070; Denmark 408.
Metal including alloys:			
Scrap	1,452	2,456	Norway 2,309.
Unwrought	4,673	4,572	United Kingdom 1,588; Denmark 1,235; West Germany 640.
Semimanufactures	1,298	1,294	West Germany 894; Belgium-Luxembourg 267.
Magnesium metal including alloys:			
Unwrought, including scrap	1,653	1,378	Norway 1,188; United States 150.
Semimanufactures	116	48	France 19; West Germany 17.
Manganese:			
Ore and concentrate	35,113	40,101	U.S.S.R. 31,220; Republic of South Africa 8,447.
Oxide	1,528	866	People's Republic of China 290; Japan 245; Belgium-Luxembourg 142.
Mercury 76-pound flasks	1,479	2,147	Spain 1,543; U.S.S.R. 289.
Molybdenum:			
Ore and concentrate	6,980	7,477	Netherlands 3,244; United States 2,845.
Metal including alloys, all forms	74	50	West Germany 14; Poland 12; Austria 4.
Nickel:			
Matte	2,602	4,651	Australia 3,034; U.S.S.R. 1,080.
Metal including alloys:			
Scrap	1,927	3,464	Switzerland 1,370; United States 1,143; United Kingdom 542.
Unwrought	13,940	11,268	United Kingdom 3,203; Australia 2,124; Norway 1,326.
Semimanufactures	6,648	4,879	Netherlands 3,245; United Kingdom 589.

See footnotes at end of table.

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Table 3.—Sweden: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Platinum-group metals and silver:			
Ores and concentrates	1,560	738	Peru 458; Colombia 280.
Waste and sweepings	154	88	United States 47; France 35.
Metals including alloys, unwrought or partly worked:			
Platinum-group value, thousands	$9,064	$8,365	Switzerland $3,106; West Germany $2,161; United Kingdom $1,764.
Silver do	$26,576	$20,659	United Kingdom $9,522; West Germany $5,247; Norway $3,574.
Tantalum do	$210	$31	West Germany $12; Belgium-Luxembourg $8; United States $5.
Tin:			
Scrap	--	46	All from Norway.
Oxide	41	43	United Kingdom 24; West Germany 19.
Metal including alloys:			
Unwrought, including scrap	805	878	Malaysia 315; United Kingdom 285.
Semimanufactures	243	260	United Kingdom 164; West Germany 74.
Titanium:			
Ore and concentrate	4,234	3,075	All from Australia.
Oxide	3,590	3,504	Finland 1,038; France 534; Norway 467.
Tungsten:			
Ore and concentrate	3,679	3,201	People's Republic of China 958; Thailand 610; Brazil 539.
Metal including alloys, all forms	103	117	United Kingdom 55; Belgium-Luxembourg 25; United States 14.
Zinc:			
Ore and concentrate	--	8,221	NA.
Oxide	1,525	1,760	Netherlands 496; East Germany 335; Poland 255.
Metal including alloys:			
Blue powder	582	514	Norway 455.
Scrap	227	193	Norway 143; Denmark 50.
Unwrought	48,357	43,592	Norway 19,364; Finland 13,317.
Semimanufactures	1,043	978	West Germany 715.
Other:			
Ores and concentrates	836	943	Austria 892.
Ash and residue containing nonferrous metals	46,295	29,368	West Germany 16,988; France 5,397; Netherlands 3,069.
Oxides, hydroxides, peroxides of metals	1,953	2,354	United Kingdom 726; Finland 695; West Germany 308.
Metals including alloys, all forms	9,291	6,649	Republic of South Africa 1,951; West Germany 1,138; France 749.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	2,172	308	Italy 137; West Germany 84; Netherlands 40.
Dust and powder of precious and semiprecious stones value, thousands	$2,070	$1,470	United States $678; Republic of South Africa $368; United Kingdom $238.
Grinding and polishing wheels and stones	3,870	2,804	Austria 852; United Kingdom 769; West Germany 372.
Asbestos	15,529	10,366	Canada 7,208; Cyprus 2,087.
Barite and witherite	5,405	6,153	West Germany 3,141; United Kingdom 2,458.
Boron:			
Crude natural borates	17,726	20,148	United States 13,460; Turkey 6,687.
Oxide and acid	920	703	United States 348; France 325.
Cement	20,187	20,667	Denmark 9,796; Finland 4,470; West Germany 2,592.
Chalk	17,620	17,379	Denmark 7,344; France 5,378; West Germany 4,177.
Clays and clay products (including all refractory brick):			
Crude	274,523	272,594	United Kingdom 223,306.
Products:			
Refractory (including nonclay brick)	165,026	131,533	United Kingdom 35,253; West Germany 32,873; Austria 28,201.
Nonrefractory	32,794	34,536	Denmark 8,936; Italy 7,176; West Germany 6,359.
Cryolite and chiolite	502	1,008	All from Denmark.
Diamond:			
Gem, not set or strung value, thousands	$12,220	$12,780	Belgium-Luxembourg $7,259; Israel $2,135.
Industrial do	$1,645	$881	United Kingdom $413; Republic of South Africa $287.
Diatomite and other infusorial earth	4,147	4,063	United States 2,085; Denmark 1,131.
Feldspar, fluorspar, etc	17,845	26,857	France 7,034; Norway 6,658; People's Republic of China 5,572.

See footnotes at end of table.

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Table 3.—Sweden: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Fertilizer materials:			
Crude:			
Nitrogenous	19,256	12,595	Mainly from Chile.
Phosphatic	675,832	580,913	Morocco 262,830; U.S.S.R. 228,496; United States 84,137.
Manufactured:			
Nitrogenous	655,414	543,374	Norway 489,949.
Phosphatic	NA	828	All from Israel.
Potassic value, thousands	(1)	$16,420	West Germany $5,858; U.S.S.R. $4,833; East Germany $3,518.
Other, including mixed	104,190	98,914	Norway 77,394; West Germany 7,900; United States 5,652.
Ammonia	102,074	85,566	Norway 39,241; East Germany 17,322; West Germany 17,293.
Graphite, natural	861	1,501	United Kingdom 446; West Germany 379; People's Republic of China 275.
Gypsum and plaster	295,396	219,879	U.S.S.R. 93,994; Spain 83,547; Poland 32,081.
Lime	3,476	2,948	Norway 1,409; Denmark 622; West Germany 590.
Magnesite	2,860	7,073	U.S.S.R. 3,760; United Kingdom 909.
Mica, all forms	738	652	Norway 232; India 140; Switzerland 77.
Pigments, mineral, processed:			
Natural, crude	122	68	West Germany 28; France 17; United Kingdom 10.
Iron oxides	5,764	7,627	West Germany 6,874.
Precious and semiprecious stones, except diamond value, thousands	$914	$1,061	West Germany $254; Switzerland $218.
Pyrite, unroasted	81,116	102,223	Mainly from Norway.
Salt and brine thousand tons	1,224	1,210	Netherlands 487; West Germany 343; United Kingdom 183.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	51,772	37,850	Belgium-Luxembourg 28,404; West Germany 6,442.
Caustic potash	1,278	962	West Germany 673; France 247.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Marble and other calcareous	760	600	Italy 353; Belgium-Luxembourg 157; Norway 75.
Slate	1,495	1,282	Norway 1,143.
Other, including granite, gneiss, etc	3,412	2,907	Norway 1,305; Finland 1,244.
Worked, all types	9,586	11,128	Portugal 4,489; Poland 2,490; Italy 2,089.
Dolomite	29,633	61,891	Norway 43,884; United Kingdom 12,115.
Gravel and crushed stone	88,544	68,027	Denmark 22,105; Finland 18,769; Norway 17,312.
Limestone (except dimension)	97,487	79,743	United Kingdom 53,909; Denmark 23,519.
Quartz and quartzite	43,298	58,273	Spain 46,280; Greece 8,746.
Sand, excluding metal bearing	301,007	545,970	Denmark 237,650; Finland 167,183; Belgium-Luxembourg 124,399.
Sulfur:			
Elemental, all forms	94,049	69,569	Poland 54,749; Finland 8,430.
Sulfuric acid, including oleum	75,209	18,238	Finland 17,445.
Sulfur dioxide	8,752	5,067	Finland 1,931; West Germany 1,907; Norway 1,229.
Talc, steatite, soapstone, pyrophyllite	22,305	22,872	Norway 12,210; Austria 3,653; Belgium-Luxembourg 2,671.
Other:			
Crude	97,313	96,456	Norway 50,534; West Germany 35,345.
Slag, dross, and similar waste, not metal bearing	2,968	19,757	Denmark 13,739; West Germany 3,263; Netherlands 2,509.
Oxides and hydroxides of magnesium, strontium, barium	20,981	18,114	Norway 11,435; Spain 2,025.
Bromine, iodine, fluorine	20	14	Chile 9; Japan 2.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	877	788	United States 437; Trinidad and Tobago 350.
Carbon black	8,693	8,291	West Germany 5,083; United Kingdom 1,281; Netherlands 1,177.
Coal and briquets:			
Anthracite and bituminous coal thousand tons	1,632	2,018	United States 789; U.S.S.R. 576; Poland 381.
Lignite and lignite briquets	15,026	9,802	Poland 6,256; West Germany 2,021; East Germany 1,525.
Coke and semicoke thousand tons	1,202	1,099	West Germany 562; United Kingdom 282.

See footnotes at end of table.

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Table 3.—Sweden: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Hydrogen, helium, rare gases	1,480	3,720	West Germany 1,406; Netherlands 1,069; United Kingdom 454.
Peat and peat briquets	775	2,197	U.S.S.R. 1,236; Finland 844.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	84,980	100,384	Saudi Arabia 20,825; Iran 19,162; United Arab Emirates 13,976.
Refinery products:			
Gasoline, aviation and motor ---do---	19,245	12,575	Denmark 4,043; United Kingdom 1,904; Finland 1,628.
Kerosine and jet fuel ---do---	2,542	4,342	United Kingdom 2,200; Netherlands 869; U.S.S.R. 449.
Distillate fuel oil ---do---	43,846	44,632	United Kingdom 8,741; U.S.S.R. 7,077; Venezuela 5,619.
Residual fuel oil ---do---	58,331	48,899	U.S.S.R. 16,639; United Kingdom 5,707; Netherlands 5,284.
Lubricants ---do---	1,080	1,715	Netherlands 408; United Kingdom 324; West Germany 245.
Other:			
Liquefied petroleum gas ---do---	744	477	Netherlands 138; United Kingdom 113; Kuwait 92.
Naphtha ---do---	7,564	10,060	Saudi Arabia 3,222; Italy 1,753; Netherlands 1,551.
Mineral jelly and wax ---do---	153	100	West Germany 51; East Germany 10.
Petroleum coke, asphalt, bitumen do---	1,033	1,004	Denmark 393; United States 290; West Germany 249.
Unspecified ---do---	1,166	1,682	Venezuela 907; U.S.S.R. 613.
Total	135,704	125,486	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	58,208	52,254	United Kingdom 14,542; Netherlands 10,939; West Germany 8,794.

NA Not available.
[1]Quantity reported as 1,344 tons.

COMMODITY REVIEW

METALS

Aluminum.—A sluggish economy decreased sales to under the 1976 level. The country's only aluminum reduction plant, located at Sundsvall on the Baltic and controlled by Gränges Aluminium AB, was operating at about 96% of its capacity of about 85,000 tons per year. Semimanufactures production was at 70% to 85% of capacity.

Copper, Lead, Zinc.—In 1977, Boliden made extensive rationalization moves at its Renström copper-lead-zinc mine located near Boliden. The company also completed expansion of its Laisvall lead-zinc mine in Norrbotten County, bringing its annual production capacity to 1.4 million tons of ore. Alteration work was begun on the Laisvall concentrating plant to allow extraction of a selective zinc concentrate. Operations at the company's Adak copper mine were terminated, and the mine installations were dismantled.

The Belgian firm Vieille-Montagne, the only foreign-owned mining company operating in Sweden, obtained a Swedish Government dispensation in 1977 to purchase a number of claims. At the company's Zinkgruvan mine, located at the northern tip of Lake Vättern near AAmmeberg, preparatory work on the 500- and 650-meter levels was intensified for full-scale operation during 1979-80. All ore that carries lead, zinc, and copper values is now treated aboveground in the new concentration plant.

The Swedish Government decided to approve LKAB's $90 million investment program for 1978 (see Iron Ore). A considerable share of the money would be allocated for construction of a copper extraction plant at the newly discovered Viscaria deposit west of Kiruna, where more than 24 million tons of ore with an average copper content of 1% was found.

Boliden obtained a concession to prospect for minerals in the Gulf of Bothnia. An aerial geodetic survey was carried out during the summer of 1977 in an area located between the towns of Lovänger and Pitea

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Table 4.—Sweden: Mineral trade with the United States, 1976[1]

Commodity	Exports		Imports	
	Quantity (metric tons)	Value, thousands	Quantity (metric tons)	Value, thousands
METALS				
Aluminum metal including alloys	1,785	$1,491	886	$1,903
Copper metal including alloys	10,086	18,622	4,744	7,735
Iron and steel metal:				
Pig iron	19,929	3,745	501	402
Ferroalloys	3,116	4,095	3,449	3,583
Steel, primary forms	25,253	5,489	1,968	2,267
Semimanufactures:				
Bars and angles	28,643	33,981	830	917
Plates and sheets	18,717	16,332	17,451	5,749
Hoop and strip	6,129	16,917	562	1,265
Rails	2,448	366	--	--
Wire	10,871	20,142	132	238
Tubes and pipes	6,019	9,252	366	1,203
Castings and forgings	368	380	336	2,126
Lead metal including alloys	--	--	26	78
Manganese ore and concentrate	--	--	1,060	146
Mercury	(2)	24	--	--
Molybdenum ore and concentrate	--	--	1,246	7,173
Nickel metal including alloys	57	406	149	1,618
Platinum-group and silver ores	(2)	1,290	24	348
Radioactive and associated materials	5	751	279	23,148
Tin metal including alloys	--	--	2	15
Zinc metal including alloys	--	--	1	2
Other nonferrous metals:				
Ores and concentrates, n.e.s.	23,018	68	56,393	1,968
Metals:				
Base metals including alloys, n.e.s	1,453	2,856	988	4,335
Scrap	486	154	5,104	4,778
NONMETALS				
Abrasives, natural, including diamond	--	--	1,706	1,066
Cement	18,006	361	--	--
Clays and refractory materials	--	--	16,909	1,815
Diamond and precious stones	12	27	--	--
Fertilizer materials:				
Crude, phosphatic	--	--	102,356	3,876
Manufactured, potash	--	--	18,455	1,070
Quartz, mica, feldspar, etc	123	22	--	--
Salt, sodium chloride	NA	3	--	--
Stone, sand and gravel:				
Dimension stone	117	73	--	--
Crushed and broken stone, sand and gravel	3,937	369	262	53
Sulfuric acid	(2)	2	--	--
Other, crude	1	(2)	767	342
MINERAL FUELS AND RELATED MATERIALS				
Coal, all types	6	7	739,544	39,607
Gas, natural and manufactured	NA	1	--	--
Petroleum refinery products:				
Lubricants	58	55	7,542	2,688
Petroleum jelly and mineral waxes	18	11	318	245
Petroleum coke, asphalt, etc	--	--	50,302	5,212
Total	XX	137,292	XX	126,971

NA Not available. XX Not applicable.
[1]Data may differ from those reported elsewhere in this chapter owing to a difference in source.
[2]Less than 1/2 unit.

Source: U.S. Department of Commerce, Bureau of the Census.

and the longitudinal axis of the Gulf.

Prospecting for copper included drilling and mapping greenstone areas west of Kiruna, where deposits similar to those at Viscaria were found. Prospecting costs for the Swedish Geological Survey were about $13 million during 1976-77 and were to increase about $700,000 annually during 1977-78 and 1978-79. The Government decreased uranium prospecting expenditures from 30% to 15% of total prospecting costs.

In 1977, Boliden continued to account for most of the nonferrous metals mined and produced in Sweden, and it operated the country's only large nonferrous smelter at Rönnskär near Skelleftea on the Gulf of Bothnia. Vieille-Montagne accounted for 30% of the zinc ore produced, which was exported for processing in the company's Belgian plants.

Swedish nonferrous ore mines with a capacity of more than 150,000 tons per year are shown in the following tabulation:

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Company and name of mine[1]	Location	Capacity (thousand metric tons per year)	Product
Boliden AB:			
Aitik[2]	Gällivare	more than 3,000	Cu.
Laisvall	Laisvall	1,000-3,000	Pb and Zn.
Stokenjokk	Vilhelmina	500-1,000	Zn and Cu.
Vassbo	Idre	300-500	Pb.
Rävlidmyran	Kristineberg	do	Cu, Pb, Zn, S.
Langsele	Boliden	do	Cu, Zn, S.
Udden	Horsjö	do	Do.
Garpenberg	Garpenberg	150-300	Cu, Pb, Zn, talc.
Garpenberg Norra	do	do	Ag, Zn, Pb.
Renström	Renströmsgruvan	do	Cu, Pb, Zn.
Kristineberg	Kristineberg	do	Cu, Zn, S.
Näsliden	Mala	do	Cu and Zn.
Stora Kopparbergs Bergslags AB: Falun Kopparverk[3]	Falun	do	Cu, Pb, Zn, S.
AB Statsgruvor:			
Yxsjöberg	Hörken	do	W, Cu, CaF_2.
Stollberg	Smedjabaken	do	Pb, Zn, Fe.
Fagersta AB: Bäckegruvan	Riddarhyttan	do	Fe and Cu.
Soc. des Mines et Fonderies de Zinc de la Vieille-Montagne: Zinkgruvan.	AAmmeberg	300-500	Zn and Pb.

[1]Underground unless otherwise specified.
[2]Open pit.
[3]Underground and open pit.

Source: Swedish Mining Association, January 1978, through U.S. Embassy, Stockholm, Sweden. State Department Airgram A-24, Feb. 24, 1978.

Iron Ore.—Swedish iron ore production decreased further under pressure from the steel slump and growing competition from new iron ore producing countries. Ownership of the iron ore mines of Gränges AB and Stora Kopparbergs Bergslags AB (SKB) was transferred at yearend to SSAB, the newly formed 50%-Government-owned steel company. Vintjärn (in central Sweden), SKB's only remaining iron ore mine, was shut down in 1977. The personnel of the Blötberget and Håksberg iron ore mines, also located in central Sweden, were informed by SSAB that operations will probably be suspended during 1979-80.

Government-owned LKAB's losses in 1977 were $145 million, owing to the steel slump and growing competition from other iron ore producing countries. The Government approved a $90 million investment program for the company in 1978, providing, among other benefits, temporary work for 850 of the 1,200 employees scheduled for discharge.

In Svappavaara, located in the Kiruna area, the concentrator and pellet plant were rebuilt in 1977, increasing pellet capacity from 2 million tons to 3 million tons per year. The mine closed in April, and the beneficiation plant was processing low-phosphorus iron ore from Kiruna.

Production was discontinued at the Ställberg and Stripa iron ore mines in central Sweden.

Iron and Steel.—During recent years, profits in Sweden's steel industry have been steadily declining, and this trend has accelerated efforts to improve the industry's structure in order to raise its productivity and increase its competitive ability both at home and in international markets. During 1977, two important official investigations—one dealing with commercial low-carbon steel and the other with specialty steels—resulted in proposals for achieving these goals.

In line with the proposed measures, the Swedish Government obtained Parliament's (Riksdag) approval in early 1978 of its bill on the formation of SSAB through the merger of Government-owned Norrbottens Järnverk AB (NJA) and the steel plants and related facilities of two large private companies (Gränges, which owns the Oxelösund facility, and SKB, which owns the Domnarvet steel plant at Borlänge). The merger also included acquisition by SSAB of several iron mines in central Sweden and the railroad (used largely for hauling ores to the port of Oxelösund) and harbor installations at Oxelösund, both owned by Gränges. The capital stock of SSAB is owned by the Government 50%, Gränges 25%, and SKB 25%.

The merger will probably result in the dismissal of 4,500 employees, out of a total of about 18,000. A special study group within SSAB is expected to present proposals in mid-1978 on how the operations of its three steel plants should be coordinated. On the

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basis of this study, SSAB's Board of Directors will decide on the final structure of the new company, including necessary shutdowns and distribution of production schedules. The study group was considering six different options regarding the volume of crude steel production, ranging from 3.2 million tons to over 4 million tons annually. The study group is expected to propose the termination of crude steel production at the Domnarvet plant, involving closure of its metallurgical section. Completion of the entire restructuring program is expected to take several years. The new company is likely to face serious readjustment problems during the period of transformation, particularly among the personnel at the plant sites, because the company's management appears determined to restore the competitiveness of its commercial steel production at all costs, even if the program should call for a sharp reduction in its labor force.

The second official investigation recommended various measures designed to bring about a comprehensive structural rationalization of the specialty steels industry. The industry is currently in a precarious position; operating costs are abnormally high, losses are mounting, and profitability is declining. Overall operating losses have about doubled in 1977, and no perceptible improvement is envisaged in the immediate future.

Tungsten.—Statsgruvor was preparing to extract scheelite ore at Högfors, located between Grängesberg and Kopparberg in central Sweden. The company's concentrating plant at Yxsjöberg was rebuilt in 1977 for separate recovery of scheelite and copper concentrate from the ores produced at the company's nearby mine.

NONMETALS

Apatite.—In 1977, apatite production, chiefly by LKAB in conjunction with iron ore mining in the Kiirunavaara area, doubled that of 1976. The Swedish Government approved a $90 million investment program for 1978. A considerable share of these funds was allotted to construction of an apatite-processing plant at Kiirunavaara, using local iron ore pellet feed tailings as its raw material.

Cement.—In 1977, AB Cementa, owned 95% by Industri AB Euroc and 5% by LKAB, remained Sweden's only cement producer, controlling seven plants with a total capacity of 3.45 million tons per year. The cement plants were located at Rullhoegan (Jönköping County), Linhamn (Malmöhus County), Slite (Gotland County), Degerhamn (on Öland Island), Hällekis, Skövde (near Lake Vänern), and Stora Vika (Stockholm County).

Limestone.— SKB began to quarry limestone at Jutjärn, near Rättvik, just north of Lake Siljan in central Sweden. The company estimates that it can extract 26 million tons of prime limestone from this site, sufficient to maintain the present level of operations at the nearby Rättviks Kalkverk for 80 years.

SKB's mineral installations that will be transferred to SSAB include the limeworks of the Rättviks Kalkverk, Osmundsbergs Kalkbrott, and Dyrkatorps Dolomitbrott companies.

MINERAL FUELS

In 1977, Sweden derived about one-fifth of its domestic energy needs from hydroelectric power and fuelwood. The remainder was supplied by imported fossil fuels, mainly petroleum, and imported enriched uranium fuel. Supply and apparent consumption of fuels and power for 1976 and 1977 are shown in table 5.

Nuclear Power.—It was reported that Sydkraft AB's new 590-megawatt-electric reactor, Barsebeck-2, located near Malmö, became critical in February. By yearend, five nuclear powerplants were in operation with a total nominal capacity of 2,900 megawatts-electric.[4] Six more nuclear powerplants were under construction with design capacity totaling 5,240 megawatts-electic.

Petroleum and Natural Gas.—Plans were announced for construction of a gas pipeline extending from the Federal Republic of Germany through Denmark to Sweden. Sydgas, the Swedish company in charge of the project, values the pipeline at $500 million, including a distribution network for supplying southern Sweden with natural gas.[5]

Svenska Petroleum AB, a Government-owned oil-purchasing company, reached an agreement with the private Norwegian Oil Consortium (NOCO) guaranteeing Sweden some 6 million tons of crude during the 1980's in return for a loan of about $100 million, subject to approval of the Governments of both countries. NOCO has a 4% share in the Tor field and a 15% share in the Valhall field, with total estimated reserves of 58 million tons in both fields.

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Table 5.—Sweden: Supply and apparent consumption of fuels and power for 1976 and 1977

(Million tons of standard coal equivalent[1])

	Total energy	Coal and coke	Petroleum and refinery products	Fuelwood black liquor, waste	Hydro-electric power[2]	Nuclear power[3]
1976:						
Production[4]	12.1	0.1	--	5.3	6.7	--
Imports	57.1	3.1	51.4	--	.8	1.8
Exports	4.7	--	4.1	--	.6	--
Apparent consumption	64.5	3.2	47.3	5.3	6.9	1.8
1977:						
Production[4]	12.0	--	--	5.5	6.5	--
Imports	53.9	2.2	48.8	--	.6	2.3
Exports	4.7	.1	3.9	--	.7	--
Apparent consumption	61.2	2.1	44.9	5.5	6.4	2.3

[1]1 ton standard coal equivalent (SCE)=7,000,000 kilocalories.
[2]Includes foreign trade of all electric power.
[3]Thermal burnoff of imported uranium fuel.
[4]Includes only primary energy.

Sources: Foreign Trade 1977, Monthly Bulletin. December 1978, p. 11.
Monthly Digest of Swedish Statistics. No. 3, 1978, p.22.

The oil and natural gas prospecting activities of the semi-Government-owned consortia Oljeprospectering AB (domestic) and Petroswede (foreign) continued. Financial frameworks reached between the participants were almost utilized in 1977, and new agreements were prepared for submission to the Parliament in 1978.

In 1977, Sweden's refining capacity (throughput) remained about 20.7 million tons per year, distributed as follows, in million tons per year:

Company	Ownership	Location of principal facilities	Approximate throughput
Scandinaviska Raffinaderi AB (Scanraff)	Government and Texaco Oil AB	Lysekil	8.3
BP Raffinaderi (Göteborg) AB	British Petroleum Co. Ltd	Göteborg	5.5
Koppartrans Olje AB	Shell Oil Co	do	5.0
AB Nynas-Petroleum	Rederi AB Nordstjernan	Nynashamn	1.4
		Göteborg	.3
		Malmö	.2

Uranium.—An LKAB application to mine 1.1 million tons of alum shale at Ranstad and extract from it as many components as possible (uranium, kerogen, heavy metals, etc.) was vetoed by local municipal authorities, and the veto was confirmed by the Swedish Government. A final Government decision on the matter is expected in 1978. AB Svensk Alunskifferutveckling, a corporation jointly owned by LKAB and Boliden, formed in the fall of 1977, is in charge of the alum shale project. The Ranstad uranium deposits are estimated to contain about 1 million tons of uranium in 14 billion tons of shale. This is equivalent to 80% to 85% of Europe's known uranium resources.[6]

[1]Physical scientist, Branch of Foreign Data.
[2]Where necessary, values have been converted from Swedish krona (SKr) to U.S. dollars at the rate of SKr4.8=US$1.00.
[3]U.S. Department of Commerce. Foreign Economic Trends and Their Implications for the U.S: Sweden. February 1978, p. 3.
[4]ASEA-ATOM in Atomwirtschaft (Düsseldorf). April 1978, p. A82.
[5]The Oilman. Jan. 28, 1978, p. 15.
[6]Financial Times (London). No. 27550, May 4, 1978, p. 2.

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The Mineral Industry of Switzerland

By Roman V. Sondermayer[1]

During 1977, Switzerland processed imported crude oil, alumina, and raw materials for iron and steel production and produced cement, lime, gypsum, salt, stone, and sand and gravel from domestic resources. Most energy requirements were met by imports of crude oil, natural gas, high-rank coals, and nuclear fuels. Hydroelectric power and nuclear power were the primary domestic sources of energy. The mineral industry of Switzerland, including processing, was significant only to the national economy; it contributed about 2% to the gross national product and employed approximately 1% of the total labor force.

During 1977, there was a change of ownership of the Bodio steelmaking facilities, and a new isomerization plant started up at the Cressier refinery.

PRODUCTION

The mineral industry was privately owned and had modern and efficient facilities. The following tabulation shows principal companies in operation in Switzerland during 1977.

Commodity	Major companies—principal facilities (Ownership)	Percent of output
Aluminum	Schweizerische Aluminium A.G.-ALUSUISSE - plants at Steg and Chippis.	80
Cement	Cement Werk Wuerenlingen - plant at Siggenthal.	36
Petroleum, refined	Raffinerie du Sud Ouest S.A. - refinery at Collombey (PB, ENI, Esso).	40
	Raffinerie de Cressier S.A. - refinery at Cressier (Shell, Gulf).	40
	Raffinerie Rheintal S.A. - refinery at Sennwald (ENI, Italy).	20
Steel, crude	Von Roll AG - plants at Gerlafingen and Bodio	75

TRADE

Swiss trade in minerals did not accurately reflect the activities of the country's minerals industry or the need for minerals. Most of the transactions recorded in nonfuels were of imports for reexport and were strictly commercial in nature. Tables 2-3 show details of Swiss foreign trade in minerals.

Switzerland had a negative trade balance in minerals with the United States. Imports from the United States were valued at $101.3 million with diamond and radioactive materials topping the list. Exports to the United States were valued at $31.5 million. Diamond, copper, and aluminum were, by value, the largest export items, as shown in table 4.

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Table 1.—Switzerland: Production of mineral commodities

Commodity[1] and unit of measure	1975	1976	1977[p]
METALS			
Aluminum smelter, primary ... metric tons	79,041	78,172	79,751
Iron and steel:			
Pig iron and blast furnace ferroalloys ... thousand metric tons	35	23	27
Electric furance ferroalloys[e] ... do	5	5	5
Crude steel ... do	420	545	[e]695
Steel semimanufactures ... do	354	547	[e]620
NONMETALS			
Cement, hydraulic ... do	3,765	3,546	3,649
Gypsum[e] ... do	70	70	70
Lime ... do	73	71	66
Salt ... do	237	312	357
MINERAL FUELS AND RELATED MATERIALS			
Gas, manufactured ... million cubic feet	4,322	2,984	NA
Petroleum refinery products:			
Gasoline ... thousand 42-gallon barrels	7,293	8,415	--
Jet fuel ... do	1,288	1,376	--
Kerosine ... do	39	39	--
Distillate fuel oil ... do	14,286	15,957	--
Residual fuel oil ... do	7,626	7,333	--
Other:			
Liquefied petroleum gas ... do	1,172	719	--
Unspecified ... do	1,558	1,467	--
Refinery fuel and losses ... do	1,876	1,469	--
Total ... do	35,138	36,775	--

[e]Estimate. [p]Preliminary. NA Not available.

[1]In addition to the commodities listed, a variety of crude construction materials (common clay, sand and gravel, and stone) is undoubtedly produced, but output is unreported and available general information is inadequate to make reliable estimates of output levels.

Table 2.—Switzerland: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Bauxite and concentrate ... kilograms	200	21,500	All to West Germany.
Oxide and hydroxide	145	155	West Germany 53; Italy 27; Sweden 9.
Metal including alloys:			
Unwrought	22,661	33,197	West Germany 14,087; Italy 10,974; United Kingdom 2,204.
Semimanufactures	44,941	57,093	West Germany 6,183; Austria 5,500; United Kingdom 4,646.
Antimony metal including alloys, all forms kilograms	667	2,070	Mainly to Bangladesh.
Arsenic trioxide, pentoxide, acids	30	[1]	NA.
Beryllium metal including alloys, all forms kilograms	130	422	United States 382.
Chromium oxide and hydroxide	4	2	U.S.S.R. 1.
Cobalt oxide and hydroxide	2	6	Mainly to Yugoslavia.
Copper:			
Ore and concentrate ... kilograms	25	--	
Matte	151	540	Austria 267; West Germany 174; Italy 65.
Copper sulfate	39	70	Austria 65; Brazil 2; France 2.
Metal including alloys:			
Scrap	6,853	7,266	West Germany 2,492; Austria 2,193; Italy 1,291.
Unwrought	3,839	5,029	West Germany 3,768; Italy 1,151; United Kingdom 70.
Semimanufactures	9,968	14,797	West Germany 2,702; Italy 1,202; France 1,162.
Gold metal, unworked or partly worked thousand troy ounces	735	1,615	Italy 819; France 143; Libya 136.
Iron and steel:			
Ore and concentrate including roasted pyrite	40	40	West Germany 22; United States 11.
Metal:			
Scrap	117,217	70,689	Italy 55,777; West Germany 10,672; Austria 2,340.
Pig iron, ferroalloys, similar materials	1,209	917	Italy 542; West Germany 116; Poland 60.
Steel, primary forms	27,324	8,737	Italy 3,364; France 3,214; West Germany 2,150.

See footnotes at end of table.

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Table 2.—Switzerland: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Iron and steel —Continued			
Metal —Continued			
Semimanufactures:			
Bars, rods, angles, shapes, sections	81,162	126,628	West Germany 69,771; Italy 25,239; France 7,926.
Hoop and strip	12,029	18,656	Austria 8,507; West Germany 6,784; France 1,881.
Universals, plates, sheets	9,322	14,675	West Germany 5,707; Austria 3,778; France 2,596.
Rails and accessories	2,069	1,320	Kenya 378; Austria 275; Greece 200.
Wire	3,104	5,287	Austria 1,199; West Germany 1,528; France 894.
Tubes, pipes, fittings	90,053	113,443	West Germany 27,326; Austria 13,676; Netherlands 10,688.
Castings and forgings, rough	624	22	France 17; Italy 5.
Ingots and semimanufactures, alloy steel and high carbon	18,330	40,950	Italy 25,326; France 5,931; West Germany 5,925.
Lead:			
Ore and concentrate kilograms	25	--	
Oxide	71	91	Mainly to Austria.
Metal including alloys:			
Scrap	5,485	7,549	Italy 3,256; Austria 2,187; East Germany 703.
Unwrought	1,768	1,512	Italy 829; West Germany 296; France 177.
Semimanufactures	58	89	West Germany 34; Belgium-Luxembourg 24; Saudi Arabia 16.
Magnesium metal including alloys, all forms	367	310	West Germany 130; Austria 40; Italy 39.
Manganese oxides	41	16	Sweden 12; West Germany 3; United Kingdom 1.
Mercury 76-pound flasks	97	31	Italy 3.
Molybdenum metal including alloys, all forms	4	(1)	Mainly to Austria and West Germany.
Nickel:			
Matte, speiss, similar materials	129	188	Netherlands 71; Sweden 59; West Germany 40.
Metal including alloys:			
Scrap	334	406	West Germany 333; Italy 37; France 16.
Unwrought and semimanufactures	1,634	2,477	France 1,374; United Kingdom 1,232; Poland 429.
Platinum-group metals and silver including alloys:			
Platinum group thousand troy ounces	428	574	Japan 239; Netherlands 68; West Germany 38.
Silver do	26,763	27,672	Italy 13,412; West Germany 2,763; Austria 2,374.
Tin:			
Oxides kilograms	793	451	NA.
Metal including alloys:			
Scrap	70	62	France 33; West Germany 26; Netherlands 3.
Unwrought	52	65	France 28; West Germany 21; Italy 10.
Semimanufactures	39	29	West Germany 20; Austria 3; Spain 1.
Titanium oxides	114	139	Austria 43; Netherlands 42; France 30.
Tungsten metal including alloys, all forms	19	133	France 49; West Germany 39; Belgium-Luxembourg 33.
Uranium and thorium oxides including rare earth oxides kilograms	2,155	1,351	Italy 197; West Germany 133; Netherlands 113.
Zinc:			
Oxide	12	3	NA.
Metal including alloys:			
Scrap	945	1,038	Italy 454; France 316; West Germany 176.
Blue powder	28	63	West Germany 51; Austria 10; France 2.
Unwrought	641	30	Austria 18; Algiers 9; Poland 2.
Semimanufactures	9	16	France 2; Netherlands 1; United States 1.
Other:			
Ore and concentrates, n.e.s.	73	52	France 18; Italy 18; West Germany 14.
Ash and residue containing nonferrous metals	22,116	23,544	West Germany 12,813; Italy 6,673; Belgium-Luxembourg 1,788.
Waste and sweepings of precious metals	120	128	West Germany 45; France 36; Belgium-Luxembourg 22.
Oxides, hydroxides, peroxides of metals, n.e.s.	241	395	United Kingdom 171; Italy 153; West Germany 28.
Metals including alloys, all forms:			
Metalloids	7,155	7,182	West Germany 4,294; Japan 1,559; United Kingdom 620.
Alkali, alkaline earth, rare earth metals kilograms	1,074	2,328	India 401.
Pyrophoric alloys do	865	139	West Germany 39; France 13.
Base metals including alloys, all forms, n.e.s.	81	69	West Germany 40.

See footnotes at end of table.

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Table 2.—Switzerland: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	7	60	France 50; West Germany 5.
Dust and powder of precious and semiprecious stones kilograms	1,111	5,266	France 3,631; Thailand 500; Italy 392.
Grinding and polishing wheels and stones	892	929	West Germany 182; Algiers 146; United Kingdom 133.
Asbestos	82	17	Austria 8; Belgium-Luxembourg 3; France 2.
Barite and witherite	4	25	Iraq 10; West Germany 3.
Boron materials:			
Crude natural borates	1	NA	
Oxide and acid	58	2	Mainly to West Germany and Italy.
Cement	28,666	17,545	Mainly to West Germany.
Chalk	125	155	France 75; West Germany 43; Austria 33.
Clays and clay products, including all refractory brick:			
Crude:	11,123	8,683	West Germany 8,404; Austria 170; France 62.
Products:			
Refractory, including nonclay brick	1,458	685	West Germany 281; Austria 153; France 71.
Nonrefractory	48,172	43,811	West Germany 19,899; France 10,446; Austria 9,440.
Cryolite and chiolite	2	11	Italy 10.
Diamond:			
Gem not set or strung value, thousands	$101,589	NA	
Industrial do	$2,006	NA	
Diatomite and other infusorial earth	12	25	Czechoslovakia 21; France 3.
Feldspar and fluorspar	380	593	Italy 325; West Germany 160; Sweden 30.
Fertilizer materials:			
Crude, phosphatic	1	(1)	NA.
Manufactured:			
Nitrogenous	424	302	Italy 127; Austria 89.
Phosphatic	34	7	NA.
Potassic	1	1	NA.
Other including mixed	1,695	776	Austria 104; West Germany 102; France 99.
Ammonia	75	76	Austria 65; France 10.
Graphite, natural	11	23	West Germany 10; Brazil 6; Italy 4.
Gypsum and plasters	3,190	2,447	Austria 2,079; France 204; Greece 129.
Lime	4,185	4,159	West Germany 3,476; France 653; Austria 20.
Magnesite	33	29	Austria 1.
Mica:			
Crude including splittings and waste	44	92	West Germany 78; Sweden 11; Peru 3.
Worked including agglomerated splittings	467	448	Sweden 80; United Kingdom 65; Austria 30.
Pigments, mineral:			
Natural, crude	66	27	Mainly to Peru.
Iron oxides processed	35	20	Italy 7; Yugoslavia 3; West Germany 2.
Precious and semiprecious stone, except diamond:			
Natural value, thousands	$107,594	NA	
Manufactured thousand carats	233,205	257,210	West Germany 83,210; Austria 36,185; France 30,760.
Pyrite (gross weight) kilograms	48	--	
Salt and brines	711	1,004	Mainly to France.
Sodium and potassium compounds, n.e.s	29,063	23,837	Austria 10,140; West Germany 7,280; Belgium-Luxembourg 5,348.
Stone and sand and gravel:			
Dimension stone:			
Crude and partly worked	34,762	34,070	West Germany 25,902; Italy 4,407; France 1,435.
Worked	9,976	11,685	Mainly to West Germany.
Dolomite, chiefly refractory grade	35	33	Chile 10; West Germany 8.
Gravel and crushed rock	19,350	12,615	West Germany 7,951; France 2,512; Austria 1,291.
Limestone (except dimension)	1	26	All to Austria.
Quartz and quartzite	27,989	30,663	Italy 27,115; West Germany 2,461; Austria 298.
Sand excluding metal bearing	10,818	10,156	France 3,713; West Germany 3,220; Italy 1,656.
Sulfur:			
Elemental:			
Other than colloidal	5	11	Mainly to West Germany.
Colloidal	22	4	Mainly to United Kingdom.
Sulfur dioxide	1,130	1,521	Austria 1,089; West Germany 432.
Sulfuric acid	16,756	15,119	West Germany 8,935; East Germany 2,758; Libya 2,525.

See footnotes at end of table.

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Table 2.—Switzerland: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Talc, steatite, soapstone, pyrophyllite	151	60	Austria 33; West Germany 8; Finland 2.
Other nonmetals, n.e.s.:			
Crude:			
Meerschaum, amber, jet kilograms	225	3	All to West Germany.
Other	1,336	15,444	West Germany 14,510.
Slag, dross and similar waste, not metal bearing:			
From iron and steel manufacture	5,569	7,179	West Germany 6,601; France 425; Italy 154.
Slag and ash, n.e.s.	119	162	Italy 156; France 5; West Germany 1.
Oxides and hydroxides of magnesium, strontium, barium	18	48	West Germany 23; Iran 16; Spain 5.
Bromine, iodine, fluorine	43	41	United Kingdom 37; Romania 2.
Building materials of asphalt, asbestos and fiber cement, unfired nonmetals, n.e.s.	2,853	2,566	France 906; Austria 578; West Germany 442.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	12	37	France 20; Trinidad 17.
Carbon black	16	82	U.S.S.R. 16; Czechoslovakia 9; France 8.
Coal, all grades including briquets	11,652	7	West Germany 5.
Coke and semicoke	13,349	589	All to West Germany.
Gas, hydrocarbon, manufactured	87	51	France 50.
Hydrogen, helium, and rare gases	25	147	Austria 97; West Germany 47.
Peat, including peat briquets and litter	1,472	1,178	Austria 825; France 352.
Petroleum refinery products:			
Gasoline, including natural thousand 42-gallon barrels	497	399	Mainly to Austria.
Distillate fuel oil do.	32	16	NA.
Residual fuel oil do.	341	167	All to Austria.
Lubricants do.	1	1	Mainly to Poland and Somalia.
Other:			
Liquefied petroleum gas do.	314	180	Italy 122; West Germany 32; Austria 25.
Petroleum coke do.	(1)	(1)	Mainly to West Germany.
Bitumen, other residues, bituminous mixtures, n.e.s. do.	4	6	West Germany 2; Austria 2; Egypt 1.
Unspecified do.	2	1	NA.
Total	1,191	770	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	467	836	West Germany 476; Sweden 104; Italy 42.

NA Not available.
[1]Less than 1/2 unit.

Table 3.—Switzerland: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite and concentrate	20,230	25,534	France 23,683; Italy 1,486.
Oxide and hydroxide	158,074	158,222	Australia 125,524; Guinea 17,323; Italy 5,476.
Metal including alloys:			
Unwrought	16,100	31,143	Iceland 11,552; Norway 11,064; Egypt 2,830.
Semimanufactures	16,435	24,235	NA.
Antimony metal including alloys, all forms	122	160	Belgium-Luxembourg 83; People's Republic of China 72; France 5.
Arsenic trioxide, pentoxide, acids	43	30	France 30.
Beryllium metal including alloys, all forms kilograms	788	1,388	United States 1,200; United Kingdom 15; West Germany 11.
Chromium:			
Chromite	4,232	NA	
Oxide and hydroxide	443	475	West Germany 323; Italy 40; United Kingdom 45.
Cobalt oxide and hydroxide	4	12	Belgium-Luxembourg 10; West Germany 1; Canada 1.
Columbium and tantalum metal including alloys, all forms, tantalum	1	1	NA.
Copper:			
Ore and concentrate	19	7	Australia 7.
Matte	33,890	21,303	West Germany 5,656; Belgium-Luxembourg 4,989; Austria 1,710.
Copper sulfate	547	745	France 304; U.S.S.R. 200; Czechoslovakia 120.

See footnotes at end of table.

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Table 3.—Switzerland: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Copper —Continued			
Metal including alloys:			
Scrap	4,170	1,945	West Germany 1,108; France 163; Austria 111.
Unwrought	1,239	1,629	West Germany 661; United Kingdom 246; Belgium-Luxembourg 219.
Semimanufactures	45,651	39,685	United Kingdom 16,156; West Germany 11,057; Belgium-Luxembourg 4,180.
Gold metal, unworked or partly worked thousand troy ounces	121	93	West Germany 49; United Kingdom 13; Denmark 9.
Iron and steel:			
Ore and concentrate, including roasted pyrite	44,640	31,835	Mauritania 27,688; Italy 2,350; Australia 1,072.
Metal:			
Scrap	96,803	43,793	West Germany 36,027; Austria 4,454; France 1,338.
Pig iron and similar materials	60,944	68,589	West Germany 37,743; France 7,923; Norway 6,745.
Ferroalloys	11,641	21,924	Norway 6,040; West Germany 2,942; France 2,881.
Steel, primary forms	95,683	93,785	West Germany 27,981; Japan 18,308; Hungary 16,045.
Semimanufactures:			
Bars, rods, angles, shapes, sections	291,258	351,069	West Germany 112,248; Italy 90,450; France 69,375.
Universals, plates and sheets	358,430	463,394	West Germany 112,914; France 68,293; Netherlands 46,580.
Hoop and strip	104,456	146,292	West Germany 53,361; Belgium-Luxembourg 32,030; France 20,008.
Rails and accessories	53,968	39,460	Austria 20,451; West Germany 11,301; France 2,212.
Wire	15,645	15,350	Austria 7,160; West Germany 4,728; Belgium-Luxembourg 1,710.
Tubes, pipes, fittings	75,878	105,609	West Germany 40,269; France 21,918; Austria 9,517.
Castings and forgings, rough	2,364	--	
Ingots and semimanufactures, alloy steel and high carbon	116,277	120,169	West Germany 48,601; France 16,180; United Kingdom 10,272.
Lead:			
Ore and concentrate	7	--	
Oxides	66	209	Mexico 150; United Kingdom 34; West Germany 8.
Metal including alloys:			
Scrap	62	48	France 44; West Germany 4.
Unwrought	14,355	14,748	France 3,923; United Kingdom 3,706; Canada 3,673.
Semimanufactures	1,243	1,205	West Germany 1,128; Belgium-Luxembourg 58.
Magnesium metal including alloys, all forms	1,286	1,501	Norway 1,170; Canada 125; U.S.S.R. 110.
Manganese oxides	472	579	Japan 287; Belgium-Luxembourg 167; West Germany 84.
Mercury 76-pound flasks	735	618	West Germany 331; U.S.S.R. 121; People's Republic of China 60.
Molybdenum metal including alloys, all forms	31	8	West Germany 5; Austria 2.
Nickel:			
Matte, speiss, similar materials	1,739	2,026	Canada 385; United Kingdom 359; Norway 325.
Metal including alloys:			
Scrap	160	295	Poland 222; West Germany 28; France 19.
Unwrought and semimanufactures	1,836	1,135	West Germany 202; United Kingdom 80; France 31.
Platinum group metals and silver including alloys:			
Platinum group thousand troy ounces	538	711	Netherlands 184; U.S.S.R. 145; West Germany 146.
Silver do	41,422	34,839	India 16,202; Mexico 4,749; United Kingdom 3,715.
Tantalum metal including alloys, all forms	1	1	Mainly from United States.
Tin:			
Ore and concentrate kilograms	--	--	
Oxides	8	6	United Kingdom 4; West Germany 2.
Metal including alloys:			
Scrap	9	24	West Germany 11; Italy 9; Sweden 5.
Unwrought	727	769	Indonesia 206; Thailand 171; Malaysia 156.
Semimanufactures	152	196	West Germany 136; France 23; United Kingdom 8.
Titanium oxides	6,258	6,754	France 2,033; West Germany 1,995; Netherlands 742.
Tungsten metal including alloys, all forms	57	23	West Germany 16; France 3; United Kingdom 2.
Uranium and thorium oxides, including rare earth oxides	12	12	France 7; Austria 2; West Germany 2.
Zinc:			
Ore and concentrate kilograms	18	50	NA.

See footnotes at end of table.

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Table 3.—Switzerland: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Zinc —Continued			
Oxide	r1,840	2,322	France 936; West Germany 648; United Kingdom 350.
Metal including alloys:			
Scrap	40	14	Yugoslavia 14.
Blue powder	2,012	1,469	Belgium-Luxembourg 595; United Kingdom 312; France 171.
Unwrought	16,887	20,169	West Germany 6,511; Netherlands 3,119; Belgium-Luxembourg 1,990.
Semimanufactures	1,118	1,063	West Germany 416; Belgium-Luxembourg 402; Austria 75.
Other:			
Ore and concentrate, n.e.s	6,094	6,499	Republic of South Africa 2,893; Australia 2,190; Italy 925.
Ash and residue containing nonferrous metals	1,028	482	West Germany 339; France 110; Italy 20.
Oxides, hydroxides and peroxides of metals, n.e.s	2,252	1,374	West Germany 977; France 117; Belgium-Luxembourg 67.
Metals including alloys, all forms:			
Metalloids	2,894	2,631	West Germany 444; France 468; Italy 243.
Alkali, alkaline earth, rare earth metals	269	316	West Germany 271.
Pyrophoric alloys	13	3	Austria 1; West Germany 1.
Base metals including alloys, all forms, n.e.s	836	790	Republic of South Africa 325; West Germany 117; France 96.
Waste and sweepings of precious metals	206	347	West Germany 513; Netherlands 19; United Kingdom 4.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	1,020	809	West Germany 360; Italy 247; United States 143.
Dust and powder of precious and semiprecious stones ——— kilograms	1,202	1,614	Ireland 709; United Kingdom 573; West Germany 4.
Grinding and polishing wheels and stones	1,532	1,421	West Germany 645; Austria 176; Italy 166.
Asbestos	17,262	18,929	Canada 7,988; U.S.S.R. 6,227; Italy 1,973.
Barite and witherite	1,948	3,089	West Germany 2,522; France 487; Italy 80.
Boron materials:			
Crude natural borates	2,480	4,109	United States 3,891; West Germany 168; Netherlands 50.
Oxide and acid	572	630	France 438; Turkey 161; West Germany 11.
Cement	126,291	115,065	Italy 73,111; West Germany 20,267; France 17,490.
Chalk	16,447	20,397	France 16,498; West Germany 1,899; Italy 1,550.
Clays and clay products, including all refractory brick:			
Crude:	193,687	176,671	West Germany 61,737; United Kingdom 53,353; France 26,165.
Products:			
Refractory, including nonclay brick	29,109	26,030	West Germany 11,980; Austria 4,463; France 2,865.
Nonrefractory	160,987	172,138	Italy 91,237; West Germany 18,917; France 8,107.
Cryolite and chiolite	840	994	Denmark 994.
Diamond:			
Gem, not set or strung —— value, thousands	$113,759	NA	
Industrial ——— do	$2,495	NA	
Diatomite and other infusorial earth	3,231	4,539	Denmark 2,473; France 1,042; West Germany 294.
Feldspar and fluorspar	9,250	12,308	West Germany 4,207; Norway 3,506; Italy 2,693.
Fertilizer materials:			
Crude:			
Nitrogenous	162	103	NA.
Phosphatic	8,737	8,124	Morocco 6,043; United States 1,007; Netherlands 839.
Potassic	15,291	NA	
Manufactured:			
Nitrogenous	31,096	59,264	West Germany 23,961; Austria 14,683; Italy 9,895.
Phosphatic:			
Thomas (basic) slag	163,289	151,332	France 100,107; Belgium-Luxembourg 51,200.
Other	3,994	6,944	France 2,644; Belgium-Luxembourg 1,865; West Germany 602.
Other including mixed	66,093	83,257	France 40,441; West Germany 21,895; Austria 6,136.
Ammonia	16,414	14,318	Austria 10,149; France 3,781.
Graphite, natural	179	219	West Germany 125; Italy 41; France 23.
Gypsum and plasters	79,731	62,455	West Germany 37,895; France 13,455; Italy 5,839.
Lime	25,776	27,849	Italy 17,970; West Germany 8,651; France 979.

See footnotes at end of table.

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Table 3.—Switzerland: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Magnesite	3,793	3,486	Austria 3,259; France 87.
Mica:			
Crude, including splittings and waste	493	657	West Germany 425; Italy 47; France 35.
Worked, including agglomerated splittings	622	571	France 417; Belgium-Luxembourg 115; Austria 24.
Pigments, mineral:			
Natural, crude	340	413	Austria 119; United Kingdom 118; West Germany 111.
Iron oxides, processed	1,962	2,322	West Germany 2,278; United Kingdom 16; Italy 9.
Precious and semiprecious stone, except diamond:			
Natural thousand carats	217,700	NA	
Manufactured do	40,180	50,700	France 38,585; Austria 2,535.
Pyrite, gross weight	32,081	8,116	Mainly from Italy.
Salt and brines	2,143	1,737	France 1,496; West Germany 208.
Sodium and potassium compounds, n.e.s	8,826	10,591	Italy 3,797; France 3,016; West Germany 2,581.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	145,930	156,415	West Germany 112,885; Italy 18,057; France 14,794.
Worked	54,812	59,324	Italy 47,785; Austria 3,068; West Germany 1,826.
Dolomite, chiefly refractory grade	12,474	12,944	Italy 10,127; France 1,867; West Germany 585.
Gravel and crushed rock thousand tons	4,061	3,858	France 2,303; West Germany 673; Italy 647.
Limestone (except dimension)	7,027	7,293	France 7,187.
Quartz and quartzite	15,321	7,516	Italy 3,626; West Germany 3,516; France 158.
Sand, excluding metal bearing thousand tons	1,097	1,073	Italy 592; France 244; West Germany 173.
Sulfur:			
Elemental:			
Other than colloidal	27,816	33,676	West Germany 30,381; France 3,246; Belgium-Luxembourg 41.
Colloidal	261	251	West Germany 152; France 99.
Sulfur dioxide	29	38	Italy 35; France 2.
Sulfuric acid	1,843	2,093	France 920; west Germany 735; Italy 152.
Talc, steatite, soapstone, pyrophyllite	9,216	9,379	Austria 5,708; France 1,454; Norway 536.
Other nonmetals, n.e.s.:			
Crude:			
Meerschaum, amber, jet kilograms	2	25,000	West Germany 25,000.
Other	36,406	43,042	West Germany 21,868; France 6,914; Netherlands 6,703.
Slag, dross and similar waste, not metal bearing:			
From iron and steel manufacture	12,144	7,776	France 3,315; Italy 3,012; West Germany 1,315.
Slag and ash, n.e.s	15,563	19,593	West Germany 18,216; France 1,231; Italy 122.
Oxides and hydroxides of magnesium, strontium, barium	282	691	Netherlands 209; Spain 124; West Germany 87.
Bromine, iodine, fluorine	2,540	2,357	France 658; United States 615; Israel 570.
Building materials of asphalt, asbestos and fiber cement, unfired nonmetals n.e.s	20,610	22,321	West Germany 8,170; Austria 6,921; France 4,728.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	1,995	1,358	Trinidad 916; France 295; United States 125.
Carbon black and gas carbon:			
Carbon black	5,723	6,448	West Germany 2,567; France 1,744; Italy 1,531.
Gas carbon	25	15	NA.
Coal, all grades including briquets	180,165	166,423	West Germany 104,022; Poland 31,530; France 8,831.
Coke and semicoke	141,157	138,179	West Germany 103,677; France 22,881; Italy 4,027.
Gas, hydrocarbon, manufactured	1	(1)	
Hydrogen, helium, rare gases	1,351	1,838	West Germany 1,146; Italy 507; France 135.
Peat, including peat briquets and litter	60,789	67,295	West Germany 54,875; U.S.S.R. 8,597; Poland 2,677.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	32,750	30,039	United Arab Emirates 10,852; Nigeria 5,753; Iran 4,410.
Refinery products:			
Gasoline, including natural do	15,168	15,020	France 4,803; Italy 4,802; West Germany 1,971.
Distillate fuel oil do	5,822	9,396	Italy 1,795; France 1,104; West Germany 795.
Residual fuel oil do	33,065	37,210	France 11,214; U.S.S.R. 7,494; West Germany 5,193.
Lubricants do	4	6	West Germany 2; Belgium-Luxembourg 1; France 1.
Other:			
Liquefied petroleum gas do	6,014	6,300	Netherlands 5,841; West Germany 451.
Petroleum coke do	473	226	Italy 159; West Germany 55; United States 7.

See footnotes at end of table.

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Table 3.—Switzerland: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Refinery products —Continued			
Other —Continued			
Bitumen, other residues, bitumious mixtures, n.e.s thousand 42-gallon barrels	1,137	1,042	France 626; West Germany 236; Netherlands 13.
Unspecified do	173	198	West Germany 61; France 57; Netherlands 23.
Total	61,856	69,398	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	32,406	34,485	France 8,090; West Germany 7,152; Netherlands 6,028.

ʳRevised. NA Not available.
¹Less than 1/2 unit.

Table 4.—Switzerland: Minerals trade with the United States, 1976[1]

Commodity	Exports		Imports	
	Quantity (metric tons)	Value, thousands	Quantity (metric tons)	Value, thousands
METALS				
Aluminum metal including alloys	1,982	$3,574	1,614	$1,845
Copper metal including alloys	5,342	8,226	538	1,921
Iron and steel:				
Metal:				
Scrap	--	--	133	110
Ferroalloys	--	--	66	617
Steel, primary forms	--	--	3	7
Semimanufactures:				
Bars and angles	2	2	175	464
Plates and sheets	NA	1	2,645	1,456
Hoop and strip	138	145	226	481
Wire	24	53	69	166
Tubes and pipes	1,263	789	137	4,308
Castings and forgings	9	26	55	107
Lead metal including alloys	--	--	1	4
Mercury	--	--	(²)	1
Molybdenum metal including alloys	--	--	200	1,223
Nickel metal including alloys	1	96	174	1,913
Platinum-group metals and silver:				
Ores	--	--	50	1,509
Metals:				
Platinum-group	(²)	1,236	1	4,051
Silver metal including alloys	NA	15	3	132
Radioactive and associated materials	190	676	653	33,737
Tin metal including alloys	--	--	(²)	2
Uranium metal including alloys	--	--	NA	2
Zinc metal including alloys	110	100	45	27
Other nonferrous metals:				
Ores and concentrates, n.e.s	--	--	213	88
Metals:				
Base metals including alloys, n.e.s	54	1,326	71	880
Scrap	331	146	1,339	1,364
NONMETALS				
Cement	NA	(²)	--	--
Clays and refractory materials	19	15	2,706	235
Diamond and precious stones:				
Industrial diamond	NA	1,019	NA	919
Gem diamond and precious stones	2	13,750	15	40,945
Stone, sand and gravel:				
Dimension stone	5	2	--	--
Crushed and broken stone, sand and gravel	--	--	252	50
Sulfur:				
Sulfur and unroasted pyrites	--	--	(²)	1
Other, crude	1,998	162	--	--
MINERAL FUELS AND RELATED MATERIALS				
Coal, all types	1	1	13,000	931
Gas, natural and manufactured	2	10	--	--

See footnotes at end of table.

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Table 4.—Switzerland: Minerals trade with the United States, 1976[1] —Continued

Commodity	Exports		Imports	
	Quantity (metric tons)	Value, thousands	Quantity (metric tons)	Value, thousands
MINERAL FUELS AND RELATED MATERIALS —Continued				
Petroleum:				
Refinery products:				
Lubricants	29	134	1,000	915
Petroleum jelly and mineral waxes	3	11	255	174
Petroleum coke, asphalt, etc	--	--	2,588	715
Total	XX	31,515	XX	101,300

NA Not available. XX Not applicable.
[1]Data may differ from that reported elsewhere in this chapter owing to a difference in source.
[2]Less than 1/2 unit.

Source: U.S. Department of Commerce, Bureau of the Census.

COMMODITY REVIEW

METALS

Aluminum.—During 1977, three aluminum plants were in operation. Two plants, one at Chippis, Valais, and the other in Steg, Valais, were operated by Swiss Aluminium Ltd. (Alusuisse). The third plant, situated at Martigny, was owned by Usine d'Aluminium de Martigny S.A. Switzerland did not produce bauxite or alumina but imported alumina from Surinam, Guinea, and Australia to meet its demand.

Iron and Steel.—The Swiss iron and steel industry makes a much narrower range of products than the main producing countries in Europe. The range is completely dominated by production of reinforcing bars, which was affected by the downswing in the activities of the building sector during 1977.

During 1977, Monteforno Acciaierie e Laminatoi S.A. (Monteforno) was taken over by Von Roll AG, the largest steel producer in Switzerland, after an option to purchase was dropped by the Italian Romi ministeel group. Economic difficulties at Monteforno, which operated electric furnaces at Bodio, had resulted from an 8-month strike and the general slowdown of the economy. The purchase included all of Monteforno's holdings in subsidiaries, including a steel trading company.

In addition to the Bodio plant and Von Roll's Gerlafingen plant, two other plants at Lucerne (A.G. der von Moosschen Eisenwerke - Von Moos) and Wohlen (Ferrowohlen AG) were in operation. Approximate total annual capacity of all four plants was 700,000 tons.

Von Roll, dating back to the 18th century, is the largest steel company in Switzerland. At Bodio, acquired from Monteforno, the company operated three 80-ton electric furnaces and one 40-ton unit. An 80-ton Daniel continuous-billet caster, a blooming mill, and four billet mills were part of the operation. Electric power was supplied by two company-owned hydropower stations. At Gerlafingen, Von Roll operated two 45-ton electric-arc furnaces and two continuous-casting machines, giving a total capacity of 200,000 tons per year. Rolling mills, a 10,000-ton-per-year forging shop, and a number of foundries at different locations with a total output of 90,000 tons per year are part of the Von Roll operations. Von Roll was the country's only producer of pig iron in a 110-ton-per-day, low-shaft furnace, which was consumed in centrifugal casting of pipes.

The Von Moos steel mill is located beside the Emme River at Emmenbrucke, near Lucerne. Steel production at this site dates back to the mid-17th century, the present company was founded in 1842. The equipment consists of a 4-strand Concast, a 50 to 60-ton electric furnace, two smaller arc furnaces, and a 170,000-ton-per-year Schloemann mill.

At Wohlen, Ferrowohlen operates facilities, built in 1955, consisting of five electric-arc furnaces with a total annual capacity of 150,000 tons of steel, a continuous-casting machine of the same capacity, and two Banning bar mills with a capacity of about 130,000 tons per year of reinforced bars.

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NONMETALS

Cement.—Cement remained the most important nonmetal produced in Switzerland during 1977. Fifteen cement plants, with an installed annual capacity of 6.2 million tons of cement, and four clinker grinding plants were in production. Of the total number of kilns, 18 were rotary dry type. Employment was about 1,600 persons. The largest cement producer remained Portland-Cement-Werk-Wuerenlingen-Siggenthal AG with its 1-million-ton-per-year plant at Siggenthal.

Other Nonmetals.—Switzerland produced salt, lime, gypsum, stone, and sand and gravel. Output of all nonmetals was of only domestic significance. Most of the salt was produced near Basel by a state monopoly and much of its output was consumed in Solvay's chemical works at Zurzach.

MINERAL FUELS

With no domestic production, imports of mineral fuels were essential to meet the energy demand of Switzerland. Domestic production of primary energy was limited to noncommercial fuels and hydroelectric power. Petroleum remained the principal source of energy in the country and accounted for 79% of the country's fuel consumption. Domestic hydropower and natural gas from abroad followed. Coal for coking and production of manufactured gas was imported since there was no production of coal.

Petroleum and Natural Gas.—During 1977, Switzerland did not produce crude petroleum or natural gas, and there was no drilling for hydrocarbons. Exploration was limited to geophysical activities mostly by Swisspetrol Holding AG (Swisspetrol), from Lake Geneva to Lake Constance aimed at the Molasse Formation of Miocene age. Swisspetrol completed half of its 7-year exploration program. Except for some show of hydrocarbons and general stratigraphic information, no discovery of commercial oil or gas was made.

The three refineries, with a capacity of 6.8 million tons, were in operation. At the Cressier refinery, a 420-ton-per-day isomerization plant, improving octane number of low-octane gasolines by 20 units, went onstream during the summer of 1977.

During 1977, Transigas AG was authorized, by pipeline authority, to double to 1,000 million cubic meters per year the volume of gas taken from the Netherlands-Italy pipeline for Swiss consumption.

Uranium.—As in 1976, three nuclear powerplants were operational, and four were in various stages of construction. When all are completed, installed capacity of nuclear powerplants in Switzerland should reach 4,500 Mwe.

[1]Physical scientist, Branch of Foreign Data.

Table 5.—Switzerland: Supply and apparent consumption of fuels and power for 1975 and 1976

(Million tons of standard coal equivalent[1])

	Total energy	Coal and coke	Petroleum and refinery products	Natural gas	Fuelwood	Hydroelectric power	Nuclear power
1975:							
Production	4.9	--	--	--	[2]	4.1	0.8
Exports	1.1	[2]	.2	--	[2]	.9	NA
Imports	20.0	0.2	18.1	1.0	[2]	.7	NA
Apparent consumption	23.8	.2	17.9	1.0	[2]	3.9	.8
1976:							
Production	4.5	--	--	--	[2]	3.7	.8
Exports	1.3	--	.1	--	[2]	1.2	NA
Imports	21.3	.3	19.4	.9	[2]	.7	NA
Apparent consumption	24.5	.3	19.3	.9	[2]	3.2	.8

NA Not available.
[1]1 ton standard coal equivalent (SCE)=7,000,000 kilocalories.
[2]Less than 1/2 unit.

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The Mineral Industry of Taiwan

By E. Chin[1]

Taiwan's gross national product (GNP) for 1977 was estimated at $20.8 billion[2] at current prices and at $11.3 billion at 1971 prices, compared with $18.1 billion and $10.5 billion, respectively, for 1976.[3] The average annual growth rate in GNP during 1953-76 was 7.3% in absolute terms, and its growth in 1977 was 8.5% over that of the previous year. The net domestic product (NDP) in 1977 was $16.1 billion in current prices. By sector, the largest inputs to the NDP were manufacturing, 28.5%; agriculture, forestry, fishery, and livestock, 13.5%; Government services, 12.8%; commerce, 11.6%; real estate ownership, 6.6%; transportation and communications, 6.3%; construction, 5.9%; and banking, 5.2%. The mining sector accounted for only 1.0% of the NDP in 1977, compared with 1.5% in 1970, and according to the Directorate General of Budget, Accounting and Statistics of the Executive Yuan, the input of the mining sector was expected to be below 1% in 1978.

The index for agriculture production (1971=100) was 123.2 in 1977 compared with 117.7 in 1976. By commodity, the major growth areas were in the value of fruits and vegetables, livestock, and fishery products. Owing to strong export demand for domestically produced goods, Taiwan's industrial production index increased 12% in 1977. Manufacturing (the largest component of the index), construction, and public utilities were the major sectors showing vigorous growth. The indices of industrial production (1972-77) for mineral-related components of the economy are given in the following tabulation:

Industrial sector	1972	1973	1974	1975	1976	1977
Mining:						
Coal	97.7	83.1	73.3	78.4	80.8	73.8
Metals	138.9	152.8	195.5	192.4	263.7	255.0
Nonmetals	114.1	131.6	128.7	155.4	260.8	333.8
Salt evaporation	64.7	56.9	54.0	39.8	71.6	73.6
Chemicals and petroleum refinery:						
Acids and alkalis	104.1	109.9	112.3	94.2	101.8	109.1
Fertilizers	110.2	122.6	144.3	115.2	161.4	167.5
Petroleum refining	124.2	149.7	126.0	137.0	189.5	212.8
Miscellaneous petroleum products	123.2	152.0	158.0	223.8	406.6	503.8
Coke	98.0	85.8	73.7	79.3	89.9	90.1
Nonmetallic mineral products:						
Structural clay products	101.5	108.6	100.9	101.8	117.3	127.5
Cement	111.1	115.4	116.9	128.7	165.7	195.4
Cement products	114.9	117.4	111.5	121.0	88.2	78.0
Metal products:						
Basic metals	112.6	132.6	130.5	112.9	147.9	172.5
Nonferrous metals	123.2	135.4	115.9	111.4	107.5	121.8

Taiwan has small coal mines, small- to medium-size quarries, and medium- to large-size industrial plants. Taiwan is deficient in minerals, except construction raw materials. Ranked by value, fuels (primarily coal and some crude petroleum and natural gas), dolomite, lime, and limestone (including marble) were the leading mineral

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products mined in Taiwan. However, output of each of these minerals was not significant in terms of the world market. Other economically important minerals mined domestically included copper, gold, salt, sulfur, and talc. However, the value of Taiwan's processing activities of imported minerals and metals continued to overshadow the value of indigenous extraction. In 1977, the mineral-processing sector outweighed the domestic mining sector 22 to 1 in output value, compared with a 16:1 ratio in 1976. A breakdown by value of output for mineral-related sectors, in million dollars, follows:

Industrial sector	1976	1977
Mining:		
Crude oil and natural gas	116	124
Coal	115	112
Metals	27	25
Evaporated salt	7	7
Miscellaneous nonmetals	32	41
Manufacturing:		
Chemical products	2,563	3,233
Oil and coal products	1,462	1,841
Basic metals	614	782
Nonmetallic mineral products	535	666
Metal products	175	225
Total	5,646	7,056

The average number of persons employed monthly by the mining and quarrying sector in 1977 was 44,546, compared with 1,270,781 in manufacturing, 286,415 in transportation and communications, 202,051 in construction, and 145,781 in services. The average number of working days per month for employees in mining and quarrying (22.4) was lower than that of the other major industrial sectors which ranged between 23.7 and 27.6 days. Employees of the electricity, gas, and water utilities had the highest average monthly earnings ($231), followed by transportation and communications ($177), construction ($164), manufacturing ($152), mining and quarrying ($135), and services ($111).

During 1968-77, Taiwan's total supply of energy increased 10.96% annually, with the largest growth resulting from imports of coal (34.98%), crude oil (18.48%), and petroleum products (15.5%). In 1977, the island's total supply of energy was estimated at 25 million kiloliters, expressed in oil equivalent. Domestic production of fuels accounted for 22% of the total, which by commodity was as follows: Coal 39%, natural gas 36%, hydroelectric power 20%, and crude oil 5%. Imports provided 78% of the total energy supply, distributed as follows: Crude oil 79%, petroleum products 20% and coal 1%. The demand for commercial energy was as follows, in million kiloliters of oil equivalent: Hydroelectric power, 1.1; thermal electric power, 7.2; coal and coal products, 1.9; petroleum products, 11.2; natural gas, 1.5; nuclear power, 0.04; exports, 1.6; and inventory adjustment, 0.4.

Taiwan's industrial consumption of energy increased 11% in 1977. The estimated breakdown of consumption, expressed in electric energy equivalent and detailed by the mineral-related industries, was as follows, in million kilowatt-hours:

Sector	1973	1974	1975	1976	1977
Mining and quarrying	311	317	339	364	381
Basic industrial chemicals	1,050	1,132	1,172	1,236	1,222
Chemical fertilizers	536	536	480	472	529
Other chemical products	1,546	1,645	2,084	2,519	2,894
Cement	763	761	885	1,127	1,311
Iron and steel	1,302	1,387	1,560	1,726	1,966
Aluminum	181	352	231	334	517
Metal products	324	325	443	523	591
Other industries	7,553	7,290	8,609	10,057	10,999
Total	13,566	13,745	15,803	18,358	20,410

In the early 1970's, the Government initiated the Ten Major Construction Projects designed to place Taiwan in the ranks of the developed countries by the end of the decade. By the end of 1977, construction on the 10 infrastructure projects was well underway, and most of them were due to be completed in 1979. The Government subsequently proposed 12 additional projects, almost all of which are a continuation of the 10 original projects. They include further expansion of railroads, highways, steel mills, harbors, nuclear powerplants, and agricultural mechanization. Additionally, Government-owned enterprises such as the Chinese Petroleum Corp. (CPC), Tang Eng

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Iron Works, and Taiwan Machinery Manufacturing Co. were to invest substantially in large-scale manufacturing facilities for heavy industry projects.

Through its contribution to exports, foreign investment continued to play an important role in Taiwan's economy, inasmuch as 28% of exports came from foreign-owned plants and factories, which generally provided more sophisticated technology and management. Foreign investment approvals in 1977 totaled $164 million compared with $142 million in 1976. Because of low labor costs and high productivity, a stable economy, and attractive investment incentives, Government approvals in 1978 were expected to reach $180 million. Since 1973, the Government has shifted its foreign investment recruitment policy toward attracting capital-intensive industries. Paralleling the increase in foreign investments, domestic private investments recovered from the depressed levels that followed the 1974-75 recession during which plant capacity utilization was sharply reduced. Growth in imports, improvements in product quality, and mechanization of labor-intensive processes are credited for the recent rise in domestic investment.

PRODUCTION

Coal was the most important mineral commodity mined in Taiwan. However, output of bituminous coal in 1977 decreased 9% to 2.9 million tons, valued at $112 million. Although crude petroleum production increased 3% over that of 1976, the principal significance of indigenous oil was as a very small supplement to imported crude oil in the production of refinery products. Natural gas output also increased 3% in 1977, but it was of little consequence by world standards.

The overall value of production by the mining industry was estimated at $310 million[4] which was distributed as follows, in million dollars: Crude petroleum and natural gas, 124; coal, 112; metals, 25; evaporated salt, 7; and miscellaneous nonmetallic mining and quarrying, 42. By comparison, the output value added by secondary and tertiary mineral-related industries was as follows, in million dollars: Chemicals and chemical products, 3,233; petroleum and coal products, 1,841; basic metals and metal products, 1,006; and nonmetallic mineral products, 666.

Other than coal, the only minerals domestically mined in significant quantities included salt, dolomite, lime and limestone, marble, clays, and soapstone.[5] Small amounts of metals were produced domestically (notably copper, iron, gold, and silver). In addition to byproduct sulfur, domestic production of other nonmetals included gypsum, serpentine, asbestos, talc, feldspar, mica, and sand.

The bulk of Taiwan's industrial output of mineral-derived products is from imported materials. Domestic production of finished articles and semimanufactures are distributed for export markets as well as internal consumption. Metal production includes ingot and manufactures of iron and steel, aluminum, copper, gold, and silver. In addition, there is significant output of derivative materials from nonmetals and petroleum refining, including mineral acids and alkalies, chemical fertilizers, chemicals, and pharmaceuticals, organic solvents and fuels, refractory brick, and cement. In 1977, the output value of the mineral-processing sector was estimated at $6.7 billion.

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Table 1.—Taiwan: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Aluminum:			
Alumina, gross weight	46,400	47,700	51,047
Metal, primary	28,111	25,512	29,740
Sheet	17,705	18,617	20,295
Copper:			
Mine output, metal content	1,900	2,000	2,000
Metal, refined, secondary	8,539	11,660	11,511
Gold metal, primary, troy ounces	22,110	26,952	14,995
Iron and steel metal:			
Pig iron	66,840	104,829	72,425
Ferroalloys (ferrosilicon)	23,178	15,761	15,621
Crude steel	519,991	597,082	644,038
Silver metal, primary, troy ounces	6,192	99,969	67,905
NONMETALS			
Asbestos	1,737	853	673
Cement, hydraulic, thousand tons	6,796	8,749	10,320
Fertilizer materials:			
Manufactured:			
Urea (46% N), do	177	191	205
Ammonium sulfate (21% N), do	483	570	602
Nitrochalk (20% N), do	31	11	18
Compound fertilizer (20% N, 5% P_2O_5, 10% K_2O), do	255	263	271
Calcium superphosphate (18% P_2O_5), do	207	195	190
Ammonia, anhydrous, do	[r]353	389	396
Gypsum:			
Precipitated	633	1,578	2,325
Other	3,054	720	5,087
Lime, thousand tons	146	164	159
Pyrite and pyrrhotite (including cuprous):[2]			
Gross weight	14,175	9,386	7,304
S content[e]	5,400	3,600	2,800
Salt, marine, thousand tons	268	497	496
Sodium and potassium compounds:			
Caustic soda	79,891	91,922	86,060
Soda ash	67,274	74,358	74,625
Stone:			
Dolomite, thousand tons	136	172	274
Limestone, do	9,479	9,612	11,679
Marble, thousand cubic meters	532	1,245	1,620
Sulfur, elemental, native, other than Frasch[3]	[r]5,472	4,470	7,778
Talc and related materials: Soapstone	12,050	15,481	10,160
MINERAL FUELS AND RELATED MATERIALS			
Carbon black[e]	[r]2,000	[r]2,200	2,500
Coal, bituminous, thousand tons	3,141	3,236	2,956
Coke, do	201	228	229
Gas, natural:[4]			
Gross, million cubic feet	55,604	64,824	66,609
Marketed, do	54,702	65,014	70,241
Natural gas liquids:			
Liquefied petroleum gas from natural gas, thousand 42-gallon barrels	558	[re]600	[e]700
Natural gasoline, do	176	[re]500	[e]1,000
Petroleum:			
Crude, do	1,351	1,555	1,597
Refinery products:			
Gasoline, do	7,378	8,500	9,778
Jet fuel, do	4,135	--	NA
Kerosine, do	132	918	[5]949
Distillate fuel oil, do	10,787	15,189	16,262
Residual fuel oil, do	26,028	43,067	48,573
Other:			
Liquefied petroleum gas, do	2,839	4,502	NA
Lubricants, do	534	1,278	760
Asphalt, do	1,563	1,679	2,308
Other, do	2,844	2,989	9,706
Refinery fuel and losses, do	1,298	1,839	4,417
Total, do	57,538	79,961	92,753

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, lead, tin, and zinc may also be produced, but information is not available.

[2]From Chinkuashih only.

[3]Excludes sulfur produced by oil refineries.

[4]Largely processed into natural gas liquids.

[5]Includes jet fuel, if any.

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TRADE

Taiwan's two-way trade in 1977 totaled $17,872 million, up 13% from that of 1976. Exports increased from $8,166 million in 1976 to $9,361 million in 1977. Similarly, imports increased from $7,599 million to $8,511 million. The largest import categories during 1977 were as follows, in million dollars: Basic metals and metal products, 3,465 (includes iron and steel, 596, and nonferrous metals, 292); nonmetallic minerals, 1,495 (includes crude petroleum, 1,320); agricultural, forest, and food products, 1,484; chemical and pharmaceutical products, 1,083 (includes chemical compounds, 461, and chemical fertilizers, 20); textiles and related products, 643; and nonmetallic mineral products, 343 (includes refined petroleum products, 288).

Textile, leather, wood, and related products, valued at $3,477 million, constituted 37% of total exports. Exports of basic metals and metal products were valued at $3,465 million, the majority of which was electrical machinery and apparatus valued at $1,568 million. In this category, exports of iron and steel and nonferrous metals were valued at only $115,000 and $20,995, respectively, illustrating Taiwan's ability to export value-added manufactures. The other leading export categories included agricultural and food products, $1,237 million; nonmetallic mineral products, $355 million (includes refined petroleum products, $183 million; cement, $44 million; and glass and glass products, $43 million); and chemical and pharmaceutical products, $218 million. Exports of nonmetallic minerals were valued at only $4 million during 1977.

Taiwan's major export destinations were the United States (39%), Japan (12%), Hong Kong (7%), and the Federal Republic of Germany (5%). Exports to Malaysia and Singapore, the United Kingdom, Canada, Saudi Arabia, and Australia each ranged from 2% to 3%.

By value, imports from Japan accounted for 31% of Taiwan's total imports, followed by the United States 23%, Kuwait 8%, Saudi Arabia 6%, and the Federal Republic of Germany 3%. Imports from Hong Kong, Malaysia and Singapore, Australia, and the United Kingdom were each around 2% of total imports.

Taiwan is dependent on imported raw materials, which account for close to 80% of total imports, to meet the demands of its export-oriented industries. Petroleum is the single largest import item. By value, about 50% of the country's foreign trade is with Japan and the United States. To counterbalance the adverse effects of currency revaluations, higher fuel costs, and other factors on the economy, Taiwan was attempting to diversify export markets and overseas supply sources. Part of this promotion program included sponsoring exhibitions of domestically produced goods and manufactures in new markets and upgrading the quality of existing product lines. Publicly funded institutes were established in the textile, electronics, and metalworking fields to aid producers in improving product quality. The Government was planning to abolish geographic restrictions on imports of more than 1,000 items in a move to reduce inflationary pressures on the economy owing to higher import prices. Also, an export-import bank was scheduled to begin operations in 1979 to assist domestic industries with export financing.

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Table 2.—Taiwan: Exports and reexports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Oxide and hydroxide	975	230	Philippines 110; Japan 100; Republic of Korea 20.
Metal including alloys, all forms	5,174	3,963	Hong Kong 1,284; Japan 1,112; Saudi Arabia 245.
Beryllium metal, waste and scrap	353	358	All to Japan.
Copper:			
Ore and concentrate	792	264	Do.
Copper sulfate	60	4	NA.
Metal including alloys:			
Scrap	400	443	NA.
Unwrought	1,673	5,267	Mainly to Japan.
Semimanufactures	4,702	3,877	Japan 1,895; Hong Kong 1,320.
Iron and steel metal:			
Scrap	32,348	98,898	Japan 43,711; Hong Kong 28,411; Thailand 12,804.
Pig iron, ferroalloys, similar materials	53,883	43,129	Japan 26,950; Thailand 3,951; Singapore 2,257.
Steel, primary forms	5,658	894	NA.
Semimanufactures:			
Bars, rods, angles, shapes, sections:			
Wire rod, other bars and rods	106,074	102,122	NA.
Angles, shapes, sections	21,883	33,380	Mainly to Indonesia and Saudi Arabia.
Universals, plates, sheets	23,676	15,722	NA.
Hoop and strip	13,419	11,199	Mainly to Indonesia and Saudi Arabia.
Rails and accessories	255	9,203	Singapore 8,625; Thailand 280; Colombia 150.
Wire	8,863	5,725	Mainly to Saudi Arabia.
Tubes, pipes, fittings	64,312	101,385	United States 51,047; Saudi Arabia 13,656.
Castings and forgings, rough	5,316	7,274	NA.
Lead metal including alloys, all forms	932	1,380	Japan 850; Singapore 223; Saudi Arabia 70.
Magnesium metal including alloys, all forms	247	243	United States 223; Japan 20.
Manganese oxide	1	--	
Mercury 76-pound flasks	17	23	All to Thailand.
Nickel:			
Matte, speiss, similar materials	61	275	Mainly to Japan.
Metal including alloys:			
Scrap	202	643	Do.
Unwrought and semimanufactures	56	41	Japan 28; Jordan 12.
Platinum-group metals and silver:			
Waste and sweepings:			
Silver troy ounces	2,347	--	
Other do	579	111,562	NA.
Metals including alloys:			
Platinum-group do	3,247	482	All to United States.
Silver do	155,545	18,455	Saudi Arabia 11,381; United States 4,758.
Tin metal including alloys, all forms	60	146	Singapore 64; Hong Kong 56; Philippines 16.
Tungsten (wolfram) metal including alloys, all forms	5	3	West Germany 1; Hong Kong 1.
Zinc:			
Oxide and peroxide	847	1,004	Japan 798; Philippines 150.
Metal including alloys, all forms	43	72	Philippines 28; Saudi Arabia 14; Japan 12.
Other:			
Ash and residue containing nonferrous metals	61	102	All to Japan.
Oxides, hydroxides, and peroxide of metals, n.e.s.	10	30	All to Indonesia.
Metals including alloys, all forms:			
Metalloids: Silicon	184	157	NA.
Alkali, alkaline-earth, rare-earth metals	1	10	All to Hong Kong.
Pyrophoric alloys	15	10	West Germany 6; Hong Kong 3.
Base metals including alloys, all forms, n.e.s.	10	484	Singapore 450; Japan 19; Indonesia 10.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	9	33	Philippines 20; Thailand 8.
Dust and powder of precious and semiprecious stones kilograms	--	230	Singapore 101; Trinidad and Tobago 99; United States 30.
Grinding and polishing wheels and stones	778	1,205	Philippines 192; Australia 191; Thailand 172.
Asbestos	8	11	Mainly to Japan.
Barite and witherite	3	21	Mainly to Indonesia.
Boric oxide, acid, borates, perborates	37	72	Mainly to West Germany.

See footnotes at end of table.

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Table 2.—Taiwan: Exports and reexports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Cement ____ thousand tons	243	543	Singapore 162; Hong Kong 160; Saudi Arabia 150.
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite	960	800	Mainly to Hong Kong.
Fire clay	3	1	All to Thailand.
Other	74	774	Mainly to Hong Kong.
Products:			
Refractory (including nonclay brick)	6,477	5,465	All to Philippines and Indonesia.
Nonrefractory	11,447	21,931	Hong Kong 7,705; Saudi Arabia 6,687; Japan 2,837.
Diamond:			
Gem:			
Not set or strung ____ thousand carats	--	355	NA.
Manufactured ____ do.	30	10	NA.
Industrial, unworked ____ do.	--	5	NA.
Diatomite and other infusorial earth	31	241	Philippines 183; Thailand 53; Japan 5.
Feldspar and fluorspar	130	4	Mainly to Costa Rica.
Fertilizer materials:			
Manufactured:			
Nitrogenous	1	500	All to Malaysia.
Potassic	2	--	
Other, including mixed	16	10	Mainly to Hong Kong.
Ammonia	85	--	
Graphite, natural	314	737	Japan 684; Netherlands 34; Canada 17.
Gypsum and plaster	210	642	Indonesia 330; United Arab Emirates 200.
Lime	4,893	9,235	All to Hong Kong.
Mica, all forms	(2)	2	West Germany 1; Republic of Korea 1.
Pigments, mineral: Iron oxides, processed	48	46	Thailand 21; Philippines 20; Indonesia 5.
Precious and semiprecious stones, except diamond:			
Natural ____ kilograms	12,252	38,528	NA.
Manufactured ____ do.	10,731	16,872	NA.
Salt and brine	6,600	427,558	Mainly to Hong Kong.
Sodium and potassium compounds, n.e.s	14,694	14,180	Hong Kong 3,928; Philippines 3,864.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	5,477	5,201	Japan 3,578; Malaysia 607; Philippines 570.
Worked	12,104	11,080	Japan 7,517; United States 1,093.
Dolomote, chiefly refractory grade	1,175	2,005	Indonesia 1,500; Philippines 500.
Gravel and crushed rock, n.e.s	53,052	18,427	Japan 17,657; Hong Kong 480.
Limestone (except dimension)	1,201	1,208	Hong Kong 1,014; Malaysia 90; Indonesia 54.
Quartz and quartzite	1	11	All to Indonesia.
Sand, excluding metal bearing	31,129	11,070	Japan 10,601; Hong Kong 400.
Sulfur:			
Elemental:			
Other than colloidal	1,188	902	Indonesia 546; Philippines 312.
Colloidal	91	206	Indonesia 80; Singapore 55; Philippines 54.
Sulfuric acid, including oleum	2,278	1,672	Mainly to Hong Kong.
Talc, steatite, soapstone, pyrophyllite	457	982	Japan 350; Indonesia 211; Hong Kong 200.
Other:			
Crude:			
Meerschaum, amber, jet	10	--	
Other	139	162	Japan 72; Philippines 51; Indonesia 17.
Slag and ash, n.e.s	2,616	1,459	Singapore 650; Hong Kong 413; Thailand 380.
Oxides and hydroxides of magnesium, strontium, barium	6	17	Singapore 10; Indonesia 5; Philippines 2.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	1,742	8,276	United Arab Emirates 4,858; Hong Kong 1,251.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black and gas carbon:			
Carbon black	134	193	Thailand 155; Singapore 34.
Gas carbon	6	7	Mainly to Hong Kong.
Coal	1	--	
Coke and semicoke	11,310	9,095	Indonesia 3,969; Singapore 2,600; Malaysia 1,260.
Rare gases: Argon ____ kilograms	2,216	--	

See footnotes at end of table.

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Table 2.—Taiwan: Exports and reexports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
MINERAL FUELS AND RELATED MATERIALS — Continued			
Petroleum refinery products:			
Gasoline ____ thousand 42-gallon barrels	--	471	NA.
Kerosine, jet fuel, white spirit ____ do	--	698	NA.
Distillate fuel oil ____ do	r369	918	NA.
Lubricants ____ do	r258	1	NA.
Other:			
Nonlubricating oils, n.e.s ____ do	2	6	NA.
Pitch and pitch coke ____ do	307	161	Indonesia 146.
Total ____ do	r936	2,255	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	40,311	178,437	Japan 176,999; Singapore 1,220.

rRevised. NA Not available.
[1]Compiled from official Taiwan trade returns, Monthly Statistics of Trade, Republic of China, May and December 1976, v. 1.
[2]Less than 1/2 unit.

Table 3.—Taiwan: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum:		
Bauxite and concentrate ____ thousand tons	114	166
Oxide and hydroxide	6,250	21,642
Metal including alloys:		
Scrap	5,886	6,208
Unwrought	11,573	36,358
Semimanufactures	2,033	9,032
Arsenic:		
Natural sulfides	1	9
Trioxide, pentoxide, acids	93	294
Beryllium metal including alloys, all forms ____ kilograms	34	32
Chromium:		
Chromite	3,467	4,579
Oxide and hydroxide	836	1,096
Cobalt oxide and hydroxide	10	46
Columbium and tantalum: Tantalum metal including alloys, all forms ____ kilograms	12	250
Copper:		
Ore and concentrate	10,000	8,025
Matte	10	7
Copper sulfate	76	153
Metal including alloys:		
Scrap	5,662	5,804
Unwrought	19,544	24,434
Semimanufactures	9,547	13,902
Germanium metal including alloys, all forms ____ kilograms	2	--
Gold metal, unworked or partly worked ____ thousand troy ounces	80	383
Iron and steel:		
Ore and concentrate	143,342	151,143
Roasted pyrite	17,590	29,479
Metal:		
Scrap	407,913	299,196
Pig iron, ferroalloys, similar materials	8,410	77,576
Steel, primary forms	16,501	81,312
Semimanufactures:		
Bars, rods, angles, shapes, sections	180,035	271,707
Universals, plates, sheets ____ thousand tons	633	859
Hoop and strip	11,164	20,792
Rails and accessories	1,688	15,947
Wire	9,465	25,290
Tubes, pipes, fittings	58,930	29,281
Castings and forgings, rough	645	585
Lead:		
Oxide	610	1,388
Metal including alloys:		
Scrap	4,474	7,679
Unwrought	5,171	6,361
Semimanufactures	23	102
Magnesium metal including alloys, all forms	70	175

See footnotes at end of table.

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Table 3.—Taiwan: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS —Continued			
Manganese:			
Ore and concentrate		79,371	41,310
Oxide		1,543	2,956
Metal		16	1
Mercury	76-pound flasks	3,573	1,578
Molybdenum metal including alloys, all forms		7	5
Nickel metal including alloys, all forms		339	1,239
Platinum-group metals and silver:			
Ores and concentrates	thousand troy ounces	(1)	64
Metals including alloys:			
Platinum-group	do.	176	109
Silver	do.	654	1,851
Selenium, elemental	kilograms	1,390	4,611
Silicon metal		172	506
Tin:			
Ore and concentrate		70	170
Oxide	kilograms	1	2,152
Metal including alloys, all forms		1,191	1,306
Titanium oxide		6,300	9,530
Tungsten metal including alloys, all forms		8	12
Uranium and thorium oxides		(2)	(2)
Zinc:			
Oxide and peroxide		340	1,191
Metal including alloys:			
Scrap		1,425	2,156
Blue powder		65	38
Unwrought		12,307	26,068
Semimanufactures		507	1,170
Other:			
Ores and concentrates:			
Of molybdenum, tantalum, titanium, vanadium, zirconium		35,498	32,082
Of base metals, n.e.s		276	74
Ash and residue containing nonferrous metals		4,969	8,379
Oxides, hydroxides, peroxides of metals		477	595
Metals including alloys, all forms:			
Metalloids, n.e.s		65	35
Alkali, alkaline-earth, rare-earth metals		6	78
Pyrophoric alloys	kilograms	1,360	569
Base metals including alloys, all forms, n.e.s.		339	304
NONMETALS			
Abrasives, n.e.s.:			
Natural:			
Pumice, emery, natural corundum, etc		1,046	2,464
Dust and powder of precious and semiprecious stones	kilograms	131	46
Grinding and polishing wheels and stones		298	421
Manufactured, artificial corundum		1,648	3,892
Asbestos		13,363	19,157
Barite and witherite		1,080	7,386
Boron materials:			
Crude natural borates		64	134
Oxide, acid, borates, perborates		4,229	4,226
Bromine	kilograms	255	156
Cement		20,141	13,915
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite		2,241	3,903
Fire clay		1,337	933
Kaolin		20,857	28,119
Other		35,078	58,889
Products:			
Refractory (including nonclay brick)		33,378	17,580
Nonrefractory		1,618	1,718
Cryolite and chiolite		5	7
Diamond:			
Gem:			
Not set or strung	thousand carats	35	60,130
Manufactured	do.	210	25
Industrial:			
Natural	do.	825	560
Manufactured	do.	5	70
Diatomite and other infusorial earth		1,022	1,377
Feldspar and fluorspar		7,933	17,885
Fertilizer materials:			
Crude, phosphatic		210,600	227,578
Manufactured:			
Nitrogenous		132,015	131,607
Phosphatic		7	25,264
Potassic		198,894	170,133
Other, including mixed		294	389
Ammonia		2	3

See footnotes at end of table.

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Table 3.—Taiwan: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS —Continued			
Graphite, natural		5,825	5,451
Gypsum and plaster:			
Gypsum		111,404	305,971
Plaster		6,718	1,713
Iodine		3	4
Lime		(2)	23
Mica:			
Crude, including splittings and waste		219	307
Worked, including agglomerated splittings		50	47
Pigments, mineral:			
Natural, crude		20	40
Iron oxides, processed		1,905	3,381
Precious and semiprecious stones, except diamond:			
Natural	kilograms	236,212	792,698
Manufactured	do	2,057	23,416
Salt and brine		375,475	1,261
Sodium and potassium compounds, n.e.s.:			
Caustic soda		5,257	99
Caustic potash, and sodic and potassic peroxides		354	1,258
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked		1,612	4,878
Worked		1,636	2,062
Dolomite, chiefly refractory grade		244	573
Gravel and crushed rock, n.e.s		491	652
Limestone (except dimension)		18	32
Quartz and quartzite		2,052	434
Sand, excluding metal bearing		343	698
Sulfur:			
Elemental:			
Other than colloidal		96,308	89,122
Colloidal		101,845	121,124
Sulfur dioxide		8	10
Sulfuric acid, including oleum		5	18
Talc, steatite, soapstone, pyrophyllite		1,646	1,868
Other:			
Crude:			
Meerschaum, amber, jet	kilograms	764	1,508
Other		37,615	64,659
Slag, dross, and similar waste, not metal bearing:			
From iron and steel manufacture		14,399	35,426
Slag and ash, n.e.s		3	4
Oxides and hydroxides of magnesium, strontium, barium		3,284	6,528
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s		49	53
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		5	55
Carbon black and gas carbon:			
Carbon black		7,848	15,628
Gas carbon		4	(1)
Coal, all grades, including briquets		77,315	213,532
Coke and semicoke		19,720	23,953
Hydrogen and rare gases		53	365
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	r55,883	91,937
Refinery products:			
Gasoline	do	33	(2)
Kerosine, jet fuel, white spirit	do	(2)	---
Distillate fuel oil	do	16,430	21,124
Lubricants (including grease)	do	301	370
Mineral jelly and wax	do	19	25
Other:			
Nonlubricating oils, n.e.s	do	25	41
Liquefied petroleum gas	do	1,017	2,105
Pitch and pitch coke	do	25	38
Petroleum coke	do	75	48
Bitumen and other residues and bituminous mixtures, n.e.s	do	(2)	(2)
Total	do	17,925	23,751
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		336	655

rRevised.
[1]Revised to none.
[2]Less than 1/2 unit.

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COMMODITY REVIEW

METALS

Aluminum.—Taiwan Aluminum Corp. (Talco) was the country's sole producer of aluminum. Talco was 100% Government owned and was integrated from alumina production through the metal-semifabricating stage. On July 25, typhoon Thelma hit southern Taiwan, inflicting substantial damage to Kaohsiung. Smelter No. 1, with an annual capacity of 38,000 tons, was severely damaged, and about 150 pots were either totally or partially decommissioned by the typhoon. By September, some 30 of the pots had been repaired and 56 more were to be online in October. Repair of 60 pots that were the most seriously damaged was to be completed by yearend.

Construction of Talco's Smelter No. 1 (annual capacity of 37,000 tons) was completed in 1976, but its commissioning was delayed. When the typhoon struck, the 60 pots in operation were shut down but were reactivated in August. The 40 that were to be brought onstream in August were scheduled for startup in October.

Alumina production in 1977 was 51,074 tons, and ingot production totaled 29,740 tons. Manufacture of aluminum sheet was 20,295 tons; foil, 2,740 tons; and miscellaneous aluminum products, 37,744 tons. The aluminum industry consumed 516.9 million kilowatt-hours of electricity in 1977 compared with 333.5 million kilowatt-hours in 1976.

Taiwan imports bauxite as the primary raw material for its aluminum industry. During prospecting for geothermal development, the Mining Research Service Organization discovered a low-grade bauxite occurrence in a 300-square-kilometer area between Tamsui and Yehliu in northern Taiwan. Ore tonnage was estimated to be in the hundred millions, averaging about 30% Al_2O_3.

Copper.—Taiwan Metal Mining Corp. (TMMC), a Government-owned company, controlled most of the copper industry in Taiwan. TMMC operates the only copper mine in Taiwan, which is located at Chinkuashih and produces around 2,000 tons (metal content) of copper annually. Copper concentrate is imported to food the 10,000-ton-per-year smelter near the mine. Metal output during the year was 11,500 tons. Lurgi Chemie was awarded contracts for construction of a 50,000-ton-per-year smelter at Taichung. Estimated cost of the project was $50 million, with completion scheduled for 1979.

Iron and Steel.—Taiwan's small magnetite placer operations are located along the northern coast between Tanshui and Wandi. Mine production was only 32,400 tons, and most of Taiwan's requirements for iron ore and concentrate were met by large tonnage imports from India and Australia to feed its Government-owned integrated steel mill. The industry's demand for other ferrous metals is met by imports of iron and steel scrap metal and by imports of old ships and vessels for scrapping.

China Steel Corp. (CSC), a State enterprise, completed the first-stage construction of its integrated steelworks at Kaohsiung on December 16. Construction was to begin on the second-stage facilities in May 1978 to increase annual output capacity from 1.5 million tons to 3.25 million tons of steel. Second-stage construction, costing $1.34 billion, was scheduled for completion in mid-1982, with financing provided equally by the Government and banking institutions.

Presently, CSC produces steel plate, rebar, wire rods, pig iron, and billet. Upon completion of the second stage, CSC's products will include hot-rolled strips and sheets, cold-rolled sheet, and base plate. A third-stage expansion was planned to increase annual capacity to 4.75 million tons, considerably below the originally planned target of 6 million tons per year.

The Government was planning measures to assist private producers of iron and steel products by providing the small producers with aid in renovating equipment, upgrading product quality, lowering costs, and expanding overseas sales. In principle, these Government-approved measures included insuring that CSC supplies high-quality pig iron at reasonable prices to small domestic users, assisting small foundries and steel mills to merge, providing technical guidance for iron smelters, and prohibiting the establishment of new private iron and steel works.

In addition to CSC, there were 34 small pig iron producers in Taiwan, 80% of them in the northern part of the island. Pig iron production during the year totaled 72,425 tons; ferrosilicon, 25,621 tons; and steel ingot, 644,000 tons. Semimanufactures of

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iron and steel in 1977 were as follows, in thousand tons: Cast iron pipe, 82; iron wire, 54; galvanized wire, 43; tin plate, 69; galvanized sheet, 36; steel rod and bar, 1,001; steel sections, 478; steel tubes and pipes, 165; steel ball, 1; and steel cable, 15. Power consumption by the iron and steel industry in 1977 was estimated at 1,966 million kilowatt-hours.

Taiwan Machinery was planning an expansion of its electrolytic tin plate facility at Kaohsiung. The project would increase its annual production capacity of tin plate from 30,000 tons to 100,000 tons. The company has a technical cooperation agreement with Aetna Standard Engineering Co. of Pittsburgh, Pa., to produce tin plate.

Tang Eng completed construction of a $39.5 million alloy steel plant in Kaohsiung. The new plant was designed to produce 75,000 tons of alloy steel per year including carbon steel, chrome steel, nickel-chrome steel, stainless steels, tool steel, spring and shaft steels, and other alloys. Facilities at the plant include a rolling mill, steelmaking shop, heat treatment shop, machine shop, forging shop, and cold finishing works. The plant was being operated under a technical cooperation agreement with Krupp Co. of the Federal Republic of Germany.

Other.—Gold was produced from vein deposits at the Chinkuashih mine. No placer deposits were being worked in Taiwan. In 1977, domestic production of gold and silver decreased 44% and 32%, respectively. Taiwan does not produce any primary zinc, lead, tin, or nickel, but consumes sizable tonnages of these metals annually. Industrial demand for these metals are met by imports primarily from Australia, Canada, Japan, Malaysia, and the United States.

NONMETALS

Cement.—Cement production totaled 10.3 million tons, 1.57 million tons more than that of 1976. Exports of cement increased sharply, reaching 1.56 million tons in 1977 compared with 543,251 tons in 1976. The principal export destinations were Hong Kong, Singapore, and Saudi Arabia. Domestic demand for cement continued to increase owing to consumption resulting from construction in connection with Taiwan's Ten Major Construction Projects, new Government projects, and increased export shipments.

There were 14 operating cement plants in Taiwan (6 in the south, 6 in the north, and 2 in the east) with a total annual production capacity of nearly 11 million tons. Most of the plants had their own limestone quarries, and only a few small plants purchased limestone raw materials from quarries operated by others. The eastern coast of the island was becoming the cement export center because of rich natural resources and Government directives aimed at accelerating the growth of eastern Taiwan. Also, the completion of the Suao-Hualien railroad provided a direct link for cement plants to Hualien Harbor.

Taiwan Cement Corp. (TCC) was the largest cement producer on the island with plants at Kaohsiung, Chutung, Suao, and Hualien, with a combined annual capacity of 3.8 million tons. Asia Cement Corp., with a 2.5-million-ton-per-year plant at Tahu near Hsinchu, ranked next to TCC. The remaining cement capacity, 4.7 million tons, was distributed among nine plants of eight companies. Energy consumption by the cement industry was estimated at 1,311 million kilowatt-hours.

Expansion and modernization programs underway or planned included a 1,000-ton-per-day expansion of Chien Tai Cement Co. Ltd., a 3,000-ton-per-day expansion of the Kangshan plant of Chia-Hsin Cement Corp., the purchase of major equipment for the new 2,200-ton-per-day plant of Hsin Hsin Cement Corp., expansion of the Hualien plant of Asia Cement from 2,200 tons to 5,200 tons per day, and a 3,200-ton-per-day expansion of the Suao plant of TCC.[6]

Fertilizer Materials.—In 1977, Taiwan produced 602,176 tons of ammonium sulfate, 395,967 tons of anhydrous ammonia, 271,407 tons of compound fertilizers, 190,206 tons of calcium superphhosphate, 204,966 tons of urea, and 18,113 tons of Nitrochalk. Taiwan has no potash resources and only small apatite resources. During 1977, Taiwan imported 314,950 tons of natural phosphates and 285,429 tons of chemical fertilizers to meet domestic demand for fertilizer materials. Energy consumption by the chemical fertilizer industry totaled 520.5 million kilowatt-hours of electricity.

Salt.—All salt production was by Taiwan Salt Works, a Government monopoly. The saltfields are distributed along the southwestern coast, and crude salt was produced by solar evaporation. In 1977, salt production totaled 496,058 tons, about the 1976 level of output. Imports of salt were over 1 million tons. The largest consumer of salt was the soda-chlorine industry, which produced 86,060 tons of caustic soda, 285,374

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tons of liquid soda, 74,625 tons of soda ash, and 30,691 tons of liquid chlorine.

Stone.—Dolomite deposits are extensive and widespread, particularly in eastern Taiwan. The most important dolomite quarries were situated along the Techoshuichi stream, north of Hualien, with lesser quarries operating near Hoping, Hojen, and Chungte. Total production of dolomite in 1977 was 274,000 tons, compared with 172,421 tons in 1976. Most of the dolomite was used by ironworks, glass manufactures, and chemical plants.

Commercial limestone deposits occur in many parts of Taiwan, and large quarries were being worked, particularly in the southwest and east. Limestone reserves were estimated at more than 450 billion tons. Production in 1977 totaled 11,679,360 tons, a 22% increase over output in 1976. The cement industry continued to be one of the largest consumers of limestone. Considerable quantities were also used for sugar refining. Burned or calcined limestone went into lime manufacture, and high-purity raw limestone was the chief raw material for making carbide cyanamide.

The crystalline limestone in the metamorphic terrain of eastern Taiwan is classified as commercial marble. Production of marble increased 33% to 4,379,385 tons in 1977. Most marble consumption was by the cement and fertilizer industries. The percentage of the total output of marble used as building stone was small, but it was increasing. Output of decorative marble in 1977 was 1.6 million cubic meters, compared with 1.2 million cubic meters in 1976 and 0.5 million cubic meters in 1975.

Other.—Sulfur production was mainly from the Kaohsiung refinery of Chinese Petroleum Corp. and from pyrite recovery from copper mining. Sulfur recovery during the year was about 7,778 tons. Taiwan produces small quantities of asbestos and gypsum from schistose rocks in the eastern part of the island. Production of other nonmetals included low-grade clay, gem stones, mica, glass sand, serpentine, and talc.

MINERAL FUELS[7]

Coal.—Coal, the most important mineral commodity mined in Taiwan, occurs mainly in northern Taiwan. The coalfields are geologically complicated, having abundant faults and folds. Generally, coal production has decreased annually since the 1960's. Output in 1977 was 2,955,915 tons compared with 3,235,810 tons in 1976. Mine production was as follows, in thousand tons:

District	Number of mines	Production
Taipei Hsien	85	1,728
Taoyüan Hsien	10	95
Hsinchu Hsien	24	155
Miaoli Hsien	27	310
Chiayi Hsien	1	--
Taipei City	18	215
Keelung City and other	23	453
Total	188	2,956

By volume, 92 mines produced less than 500 tons per month, 22 mines between 500 and 1,000 tons per month, 54 between 1,000 and 2,000 tons per month, 10 mines between 3,000 and 5,000 tons per month, and 10 mines above 5,000 tons per month. Under the current economic plan, the target output for coal in 1977 was 3.3 million tons, decreasing to 3.1 million tons in 1978. Sales of coal to major end users in 1977 were as follows, in thousand tons:

End User	Source	
	Domestic	Imported
Government enterprises:		
Taiwan Power Co	551	19
China Steel Corp	--	637
Taiwan Railroad Co	106	--
Taiwan Sugar Corp	29	--
Other	89	--
Private enterprises:		
Taiwan Cement Corp	105	--
Chia-Hsin Cement Corp	89	23
Asia Cement Corp	66	--
Global Cement Corp	64	15
Other cement plants	180	--
Other	1,672	24

About 20% of the coal produced in Taiwan was classified as coking coal. Pioneer Chemical Corp. and Hsin-Chu Chemical Corp. operated the only byproduct coke plants in Taiwan; both also produced coal gas for municipal use. Total production of coking coal in 1977 was 229,000 tons including 153,000 tons of metallurgical coke and 26,000 tons of foundry coke. The principal domestic user industries were iron and steel works and carbide and plastic manufacturers.

Natural Gas.—The Government's production targets for natural gas in 1977 and 1978 were 1,902 million and 2,145 million cubic meters, respectively. Actual output in 1977, however, totaled 1,886 million cubic meters. Production was largely from 20 producing wells in the Chinshui gasfield and from 29 producing wells in the Tiehchenshan gas-

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field. Taiwan's natural gas reserves were estimated at 29 billion cubic meters. While annual production is small by world standards, the island's output and reserves of natural gas were considered an important energy supplement sufficient to meet the current consumption level of natural gas.

Petroleum.—Production of crude oil in 1977 was 253,928 kiloliters (about 216,000 tons), a 3% increase over that of 1976. Domestic production equaled less than 2% of crude oil imports in 1977. During the year, Taiwan imported 13,569,000 tons of crude oil valued at $1,251 million and 3,316,926 tons of refined petroleum products valued at $273 million.

CPC produces, imports, refines, and markets all petroleum, natural gas, and their products used in Taiwan. CPC owns seven 100,000-ton tankers and one 36,000 ton ship, which collectively are capable of handling 70% of the crude oil Taiwan imports to meet its needs. In addition, CPC maintains loading and storage facilities for the imported oil; its storage field contains six tanks capable of holding 450,000 tons of crude oil.

CPC has two refineries in operation at Kaohsiung; one has a capacity of 334,500 barrels per day, and the other, which came onstream in 1977, has a capacity of 100,000 barrels per day. Construction of a new refinery at Taoyüan, with a capacity of 100,000 barrels per day, was scheduled for completion late in the year. Additionally, CPC operates two petrochemical complexes —One at Kaohsiung (the largest), which utilizes petroleum as its raw material, and the other at Toufen in the north, which uses natural gas. Kaohsiung has three naphtha crackers—one with an annual capacity of 54,000 tons of ethylene and two with annual capacities of 230,000 tons of ethylene. CPC also has invested in downstream plants, including China Petrochemical Development Corp., Chung-Tai Chemical Industries Corp., Taiwan Alkali Co., Taiwan Polypropylene Co., and China American Petrochemical Co. Principal products produced in 1977 were as follows, in kiloliters: Fuel oil, 7,722,557; diesel oil, 2,585,508; gasoline, 1,554,575; lubricating oil, 120,801; and kerosine, 50,906.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from New Taiwan dollars (NT$) to U.S. dollars at the rate of NT$36=US$1.00.

[3]U.S. Embassy, Taipei, Taiwan. State Department Airgram A-87, Sept. 27, 1978, 14 pp.

[4]Council for Economic Planning and Development. Industry of Free China. V. 1, No. 1, January 1979, p. 103.

[5]U.S. Embassy, Taipei, Taiwan. State Department Airgram A-80, Aug. 17, 1978, 4 pp.

[6]Rock Products. Taiwan. V. 82, No. 4, April 1979, pp. 114-116.

[7]U.S. Embassy, Taipei, Taiwan. State Department Airgram, A-58, June 8, 1978, 7 pp.

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The Mineral Industry of Tanzania

By David E. Morse[1]

Mineral production in Tanzania remained modest by world standards in 1977. Diamond, salt, and other gem stones were the only commodities exported in significant quantities. The State Mining Corp. through subsidiaries controlled the nation's mining operations, conducted mineral exploration, and, in cooperation with teams from several foreign countries, assessed beach sand deposits along the southern coast, kaolin resources at Pugu Hill, coal deposits near Mbeya, and iron ore deposits in the Chunya region. The mineral resources of Tanzania have not been fully evaluated since the country has been only 60% surveyed geologically and 20% prospected.

The third 5-year development plan, which began in July 1977, projected a 6% annual increase in the gross domestic product (GDP). The emphasis of the plan was the development and processing of domestic raw materials to supply local industry. Development of an iron and steel industry in the Mbeya region and expanded cement production were among the major projects of the plan. Planned growth in the mining sector was to be 9.3% per year during the 5-year period.

In February, Tanzania officially closed the border between Tanzania and Kenya. This action significantly affected many domestic firms that relied on Kenya as a supplier of raw materials, spare parts, and consumer goods. It also signaled the end of the East African Community (EAC), a commercial and shared-service pact among Tanzania, Kenya, and Uganda. Tanzania created new organizations in 1977 to replace the airline, rail, and harbor corporations that had been managed by EAC.

PRODUCTION

Diamond retained its position as the most important mineral product in terms of value in 1977 although output declined 7%. Petroleum refinery throughput and solar-evaporated salt production also declined during 1977. Gold production increased significantly owing to the start of trial milling of ore from the Lupa goldfield. Cement production from the Wazo Hill plant increased 7.8% over that of 1976. Production of gem stones other than diamond continued on a small scale from mines in the Merelaui area in northern Tanzania.

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Table 1.—Tanzania: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Gold, refined—troy ounces	[1]78	10	[e]5,500
Silver, refined—do	18	1	--
Tin, mine output, metal content	2	3	--
NONMETALS			
Cement	266,000	241,000	260,000
Clays: Kaolin	1,004	[e]1,000	[e]1,000
Diamond:			
Gem[e 2]—carats	223,902	219,104	204,016
Industrial[e 2]—do	223,903	219,105	204,016
Total—do	447,805	438,209	408,032
Gem stones, precious and semiprecious, except diamond:[3]			
Amethyst—kilograms	20	7	2
Aquamarine—do	5	(4)	NA
Beryl (gem only)—do	135	46	67
Chrysoprase and opal—do	--	(4)	--
Corundum (gem only)—do	4	--	--
Garnet and rhodolite—do	69	30	20
Ruby and sapphire—do	2	1	1
Scapolite—do	13	3	7
Tourmaline—do	1	13	3
Zircon—do	7	3	20
Zoisite (tanzanite)—do	9	10	(4)
Unspecified—do	1,290	33	55
Gypsum and anhydrite, crude	12,839	[r e]8,000	4,000
Lime, hydrated, and quicklime	2,373	[e]2,000	[e]2,000
Mica, sheet	6	7	7
Salt, all types	44,390	[r e]35,000	[e]30,000
Stone, sand and gravel:			
Calcite	5,390	NA	NA
Ornamental stone:			
Art stone	3	25	16
Amethystine quartz	(4)	NA	NA
Glass sand	28,880	[e]28,000	[e]28,000
MINERAL FUELS AND RELATED MATERIALS			
Coal, bituminous	850	3,000	3,000
Petroleum refinery products:			
Gasoline—thousand 42-gallon barrels	767	[e]989	895
Kerosine—do	127	[e]212	349
Jet fuel—do	411	[e]420	241
Distillate fuel oil—do	2,411	[e]2,585	1,170
Residual fuel oil—do	1,275	[e]2,361	1,847
Liquefied petroleum gas—do	52	[e]68	72
Refinery fuel and losses—do	324	[e]389	227
Total—do	5,367	[e]7,024	4,801

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]Exports.

[2]Estimates based on reported total diamond output and best available information on the ratio of gem to industrial stones in total output.

[3]Exports, including transfers to Kenya and Uganda.

[4]Less than 1/2 unit.

TRADE

Diamond, salt, and other gem stones were the major mineral exports of Tanzania in 1977. Diamond exports declined 39% in quantity but only 29% in value owing to an increase in the world market price. Exports of residual fuel oil from the Dar es Salaam refinery were valued at $8.6 million.

During 1977, imports were restrained by the Government as they had been in 1975 and 1976. The balance-of-trade deficit in 1977 was approximately $103 million compared with $72 million in 1976 and $296 million in 1975. The balance-of-payments picture brightened; the deficit was $11 million in 1977 compared with $45 million in 1976 and $229 million in 1975. Imports of fuel and lubricants, valued at approximately $106 million, continued to be a burden on the economy despite a 30% decrease in the volume of imported crude oil.

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Table 2.—Tanzania: Exports and reexports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS			
Aluminum metal including alloys:			
Scrap		139	65
Unwrought and semimanufactures		1,076	212
Copper metal including alloys:			
Scrap		192	188
Unwrought and semimanufactures	value	--	$4,102
Iron and steel metal:			
Scrap		160	387
Semimanufactures:			
Bars, rods, angles, shapes, sections		149	355
Universals, plates, sheets		16	41
Rails and accessories		9	--
Wire		27	16
Tubes, pipes, fittings		2,922	222
Lead metal including alloys:			
Scrap		253	145
Unwrought and semimanufactures	value	$1,349	--
Tin ore and concentrate		40	22
Zinc metal including alloys: Scrap		r108	515
Other: Ash and residue containing nonferrous metals		48	70
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc.		--	15
Dust and powder of precious and semiprecious stones		(2)	--
Grinding and polishing wheels and stones		4	(2)
Cement		954	1,861
Clays and clay products (including all refractory brick):			
Crude		242	139
Products, refractory (including nonclay brick)		5	--
Diamond, gem, not set or strung	thousand carats	595	446
Feldspar and fluorspar		6	--
Fertilizer materials, manufactured, phosphatic		718	--
Gypsum and plaster		1	3,600
Lime		1	--
Mica, crude, including splittings and waste		7	8
Precious and semiprecious stones, except diamond, natural	value, thousands	$379	$477
Salt and brine		8,824	9,141
Stone, sand and gravel:			
Gravel and crushed rock, n.e.s.		4	--
Quartz and quartzite		75	--
Sand, excluding metal bearing		--	3
Sulfur: Sulfuric acid, including oleum		372	--
Other, crude	value	$3,123	$59
MINERAL FUELS AND RELATED MATERIALS			
Coke and semicoke		7	2
Petroleum refinery products:			
Gasoline	thousand 42-gallon barrels	167	176
Kerosine	do.	26	31
Jet fuel	do.	61	92
Distillate fuel oil	do.	147	150
Residual fuel oil	do.	1,308	1,359
Lubricants	do.	1	1
Other:			
Nonlubricating oils, n.e.s	do.	(2)	(2)
Liquefied petroleum gas	do.	(2)	4
Bitumen and other residues and bituminous mixtures, n.e.s	do.	(2)	--

r Revised.
[1] Includes transfers to Kenya and Uganda.
[2] Less than 1/2 unit.

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Table 3.—Tanzania: Imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS			
Aluminum metal including alloys:			
Scrap		28	--
Unwrought		1,630	3,427
Semimanufactures		454	483
Copper metal including alloys:			
Scrap		3	--
Unwrought		1	1
Semimanufactures		302	134
Iron and steel:			
Ore and concentrate		1,500	1,050
Metal:			
Pig iron, ferroalloys, similar materials		2,666	1,195
Steel, primary forms		11,617	17,923
Semimanufactures:			
Bars, rods, angles, shapes, sections		10,747	8,707
Universals, plates, sheets		21,029	27,166
Hoop and strip		8,301	11,132
Rails and accessories		18,880	198
Wire		6,490	4,465
Tubes, pipes, fittings		16,587	18,918
Castings and forgings, rough		13	8
Lead:			
Ore and concentrate	value	$69	--
Metal including alloys:			
Scrap		1	--
Semimanufactures		32	39
Nickel metal including alloys: Unwrought and semimanufactures	value	$4,431	$7,129
Platinum-group metals including alloys, all forms, but not rolled	troy ounces	1	123
Silver metal including alloys, but not rolled	do.	96	119
Tin metal including alloys:			
Unwrought		12	16
Semimanufactures		10	42
Zinc metal including alloys:			
Blue powder		--	1
Unwrought		3,732	4,095
Semimanufactures		132	4
Other metals including alloys, all forms:			
Pyrophoric alloys	value	$19	(2)
Base metals including alloys, all forms, n.e.s		1	3
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc		11	12
Dust and powder of precious and semiprecious stones		2	2
Grinding and polishing wheels and stones		57	82
Asbestos		70	65
Barite and witherite		308	1,690
Cement		60,361	32,095
Chalk	value	$118,558	$1,578
Clays and clay products (including all refractory brick):			
Crude		1,062	1,545
Products:			
Refractory (including nonclay brick)		1,094	1,862
Nonrefractory		1,335	826
Diamond, gem, not set or strung	thousand carats	124	214
Diatomite and other infusorial earth		293	156
Feldspar and fluorspar		116	--
Fertilizer materials:			
Crude:			
Phosphatic		22,213	49,387
Potassic		10	--
Manufactured:			
Nitrogenous		39,880	31,955
Phosphatic		1,307	1,515
Potassic		9,032	5,695
Other, including mixed		2,322	10,125
Ammonia		5,181	6,970
Graphite, natural		8	1
Gypsum and plaster		229	47
Lime		332	5
Magnesite		115	75
Mica:			
Crude, including splittings and waste	value	$7,055	$14,743

See footnotes at end of table.

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Table 3.—Tanzania: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS —Continued			
Mica —Continued			
Worked, including agglomerated splittings	value	$6,608	$1,254
Pigments, mineral, natural, crude	do	$8,691	$23,268
Salt and brine		1,176	2,240
Sodium and potassium compounds, n.e.s.:			
Caustic soda		2,352	6,857
Sodium carbonate (soda ash)		4,417	183
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked		17	13
Worked		47	--
Dolomite, chiefly refractory grade		30	--
Gravel and crushed rock, n.e.s		97	--
Quartz and quartzite		2	2
Sand, excluding metal bearing		25	18
Sulfur:			
Elemental, other than colloidal		453	27,680
Sulfuric acid, including oleum		83	2,558
Talc, steatite, soapstone, pyrophyllite	value	$73,952	$36,693
Other:			
Crude:			
Meerschaum, amber, jet		25	18
Other	value	$24,512	$1,361
Slag, dross, and similar waste, not metal bearing from iron and steel manufacture		357	42
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		5	--
Coal, all grades, including briquets		64	122
Coke and semicoke		521	833
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	5,367	7,046
Refinery products:			
Gasoline	do	143	175
Kerosine	do	204	58
Jet fuel	do	109	176
Distillate fuel oil	do	700	664
Residual fuel oil	do	52	--
Lubricants	do	173	29
Mineral jelly and wax	do	5	10
Other:			
Liquefied petroleum gas	do	(2)	(2)
Nonlubricating oils, n.e.s	do	4	7
Pitch and pitch coke	do	1	(2)
Bitumen and other residues	do	41	346
Bituminous mixtures, n.e.s	do	26	73
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals/486/(2)			

[1]Includes transfers from Kenya and Uganda.
[2]Less than 1/2 unit.

COMMODITY REVIEW

METALS

Gold.—Small scale production of gold has continued in Tanzania since 1970 when the last major gold mine was closed for lack of ore. Development work and trial milling at the Lupa goldfield produced an estimated 5,466 troy ounces in 1977. The Lupa operation was to be commissioned in 1979 and will produce about 9,600 troy ounces of gold per year. Work on development of the Buck Reef project in the Rwamagaza area of the Geita District continued in 1977. Preliminary work at Buck Reef indicated reserves of 100,000 tons grading 0.3 troy ounce per ton. The Buck Reef project was to come onstream in 1979 and produce 1,125 troy ounces of gold per month.

Iron Ore.—Teams from the People's Republic of China continued a program of study and evaluation on the Chunya iron ore deposits in southwestern Tanzania. The Government planned to develop an iron and steel industry near Mbeya based on iron ore from the Chunya deposits and coal from the Songwe-Kirwera coalfields.

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NONMETALS

Cement.—Output of cement from Tanzania's only cement plant at Wazo Hill near Dar es Salaam remained well below rated capacity of 340,000 tons per year. Cement imports continued to increase to meet the country's cement demand. An expansion program was in progress to increase capacity at the Wazo Hill facility to 600,000 tons per year. Two new cement plants were under construction: F. L. Smidth of Denmark was supplying the major components for a 500,000-ton-per-year cement plant at Tanga in the northeast and a 250,000-ton-per-year plant at Mbeya in southwestern Tanzania near the Zambian border. The Wazo Hill expansion was to come online in 1978, and the new plants at Tanga and Mbeya were to commence production in late 1979.

Diamond.—Diamond production decreased 7% in quantity but increased 15% in value owing to the increase in price on the world market. The Mwadui mine in northern Tanzania was responsible for the bulk of the nation's production and the decline in production was attributed to the decreasing grade of ore treated.

Gem Stones.—A wide variety of gem-quality minerals were produced by smallscale operations in northern Tanzania. In 1977, gem stone production of amethyst, beryl, corundum, garnet, zircon, and zoisite (tanzanite) was valued at approximately $81,000. Tanzania Gemstone Industries, Ltd. functioned as the nation's only authorized dealer to export precious and semiprecious stones.

Fertilizer Materials.—*Phosphate.*—State Mining planned to mine the guano derived phosphate deposits at Minjingu Koje near Lake Mangara, 112 kilometers west of Arusha in northeastern Tanzania. The deposit contains approximately 10 million tons of ore with an average grade of 20% P_2O_5. Samples have been sent for testing to the Tanga fertilizer plant which manufactures complex fertilizers from imported materials.

Salt.—For the past several years, salt has been one of Tanzania's most valuable mineral products. The largest producer was Nyanza Salt Mines Ltd., which produced salt by solar evaporation of brines pumped from saline springs at Uvinza, 110 kilometers east of Kigoma. The Uvinza operation satisfied the salt demand of western Tanzania and exported about 6,800 tons to Zaire and Zambia. Coastal saltworks near Tanga, Dar es Salaam, Kunduchi, Mtwara, and Lindi produced salt for domestic consumption. An additional and considerable amount of salt was collected from various salt lakes and playa deposits by local inhabitants for their own consumption and for trading purposes.

Other.—Minor quantities of kaolin and glass sand were extracted from the Pugu Hills, about 25 kilometers west of Dar es Salaam. Kaolin reserves there were estimated to be 2 billion tons, and State Mining has attempted to raise sufficient capital to finance a large-scale operation (50,000 tons per year).

The Lake Natron soda ash deposits have been studied, and Japanese firms have expressed considerable interest in their development. The lack of adequate transport facilities and the existence of an established soda ash operation at Lake Magadi in Kenya have deterred development at Lake Natron.

MINERAL FUELS

Coal.—Teams from the People's Republic of China continued investigations in the Songwe-Kiwera coalfields in southwestern Tanzania near the Malawi border. The studies and recommendations to the Government are to be completed by 1980.

Natural Gas.—The Oil and Natural Gas Commission (ONGC) of India, working under a service contract for the State agency Tanzania Petroleum Development Corp. (TPDC), confirmed a natural gas discovery on Songo Songo Island in 1977. Estimated reserves were placed at 30 billion cubic meters. ONGC planned to drill another well to assess the size of the reservoir in 1978.

Petroleum.—Efforts to find an indigenous supply of crude oil in Tanzania continued in 1977. Agip Tanzania Ltd. held a service contract with TPDC covering a 16,486-square-mile onshore and offshore area along the eastern coast. Oceanic Exploration Co. retained a 15,400-square-mile offshore area under a service contract with TPDC. Service contracts required that the companies bear all development costs with the Government in order to receive 50% of any production.

The Dar es Salaam petroleum refinery operated by Tanzania & Italian Petroleum Refining Co. Ltd. had a throughput of 664,000 tons in 1977 and provided most of the nation's requirement of refined petroleum products. Imports of crude oil and petroleum products continued to be restrained owing to Tanzania's foreign exchange shortage.

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[1]Physical scientist, Branch of Foreign Data.

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The Mineral Industry of Thailand

By Gordon L. Kinney[1]

The Thai economy registered gains in construction, mining, and manufacturing, and benefited from higher agricultural and mineral export prices and increased tourism in 1977. The economy showed an improvement over 1976; Thailand reached the targeted growth rate of 7%. These gains would have been larger except for lagging productivity in the agricultural sector, serious drought in one section of the country, and a record high foreign trade deficit. Although declining food prices in December kept the inflation rate just under 10%, price rises in other commodities caused serious concern that real wages would deteriorate for the workers. The rate of inflation will likely surpass 10% in 1978.

The gross national product for 1977 was reported to be over $18 billion,[2] a growth of more than 11% at current prices and more than 7.7% in terms of constant 1962 prices.

Farming continued to employ about 70% of the labor force but its relative importance in the Thai economy dropped from 34% of the gross domestic product (GDP) in 1973 to a little over 28% in 1977. Mining and quarrying, on the other hand, have gained in relative importance during the last 3 years, contributing 1.3% of GDP in 1975, 1.42% in 1976, and 2.0% in 1977. The increased value was also reflected in the employment data, which varied widely from month to month. Total mining industry figures, with December as the index month, showed that employment increased from 40,000 in 1975 to over 58,500 in 1977. The tin and tin-tungsten operations were the dominant employers in the mining industry and Thailand's relative dependence on these operations for mining employment has increased steadily in recent years, from 75% in 1974 to over 83% of the mining work force in December 1977.

Several developments in the tin sector contributed to a 66% increase in the value of tin production in 1977. A major factor was a substantial rise in the world price of tin. Another was that Billiton Thailand Ltd., and the Government's Offshore Mining Organization signed a sliding scale agreement to dredge for tin in the offshore waters. This permitted the dredge *NARAI*, the world's largest suction-cutter dredge, to resume operating after nearly 2 years of inactivity. The additional production from *NARAI* contributed to the 18% increase in overall tin production.

In the natural gas sector, two more gas strikes confirmed the availability of commercial deposits of natural gas in the Gulf of Thailand. The overall situation, however, showed little change during the year because no agreement was reached in tedious gas-pricing negotiations between the oil companies and the Government. Eventually, the development of the domestic natural gas reserves will be a strong stimulus to industrial growth of the Sattahip to Bangkok area, and will help to lessen the current large foreign exchange outlay for imported crude oil.

The new Investment Promotion Act officially became effective on April 29, 1977. Its primary purpose was to encourage investment outside the Bangkok metropolitan area. Mineral prospecting, mining, ore dressing, smelting, and the processing or production of various metals or nonmetallic minerals were among the areas that were eligible for promotional privileges. The Act created 10 investment promotion zones, with extra investment incentives. These incentives included a substantial business tax reduction for up to 5 years, a 50%

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reduction of corporate income tax for 5 years, liberalized tax deductions from taxable corporate income, and tax deductions for infrastructure construction expenses for 10 years.[3]

The new law reportedly makes Thailand as favorable an area for investment in terms of promotional privileges as any country in the area. The passage of the law emphasized the Government's concern for hastening economic development in Thailand. Further encouragement to investment was provided by the establishment of an Investment Services Center. This was to be a "one-stop shop" where potential investors could obtain the necessary permits and approvals needed to begin a new mining or production operation. Businessmen had previously complained of lengthy delays and the undue redtape needed before any project was approved.

Just 1 year after the military seized power and installed Tanin Kraivicxien as Premier, the same group of generals who appointed him, removed him from office and an interim Government was announced on November 11, 1977, headed by General Kriangsak Chamanan. The new Government was well received by the people and the business community.

PRODUCTION

Thai mineral production is strongly oriented to the export market. Domestic demand is negligible except for small amounts of lignite, barite, manganese, lead, and some of the nonmetallics used in the construction industry. Production of tin and tungsten increased markedly in response to higher world prices. Production of manganese ore, gypsum, fluorite, feldspar, kaolin, iron ore, marl, quartz, and limestone also increased. On the other hand, antimony ore, lead ore, barite, phosphate, and lignite production all decreased. The value of tin concentrate production for 1977 was approximately $250 million, a 66% increase over the 1976 figure. Tungsten concentrates were valued at $45 million, up 50% over 1976.[4] The overall value of mineral production increased by more than 50%, to $331 million in 1977, surpassing the previous record of $231 million set in 1974.

Table 1.—Thailand: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Antimony:			
Ore:			
Gross weight	7,372	8,637	5,774
Metal content	3,133	3,671	2,454
Smelter	336	480	159
Chromium, chromite, gross weight	200	--	490
Columbium and tantalum, ore and concentrate, gross weight:			
Columbite	7	--	8
Tantalite	103	6	41
Iron and steel:			
Iron ore, 55% iron, gross weight	32,476	25,000	63,470
Pig iron	12,626	11,530	19,333
Ferroalloys:			
Ferrosilicon	393	1,159	--
Ferromanganese	831	1,509	--
Steel, primary forms:			
Ingots	236,224	162,840	[e]180,000
Billet	[e]240,000	112,276	[e]120,000
Semimanufactures (selected):			
Bars	67,756	93,210	NA
Galvanized iron sheets	83,146	90,000	NA
Tinned plates	20,889	NA	NA
Lead:			
Mine output, metal content	1,533	904	506
Metal, unwrought ingot	944	825	1,181
Manganese ore:			
Battery grade and chemical grade, 75% MnO_2	3,577	3,230	4,762
Metallurgical grade, 46% to 50% MnO_2	20,493	46,865	72,137

See footnotes at end of table.

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Table 1.—Thailand: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS —Continued			
Manganese ore —Continued			
Chemical grade, over 75% MnO_2	844	130	63
Total	24,914	50,225	76,962
Monazite, gross weight	367	--	--
Tin:			
Mine output, metal content	16,406	20,452	24,205
Smelter:			
Primary	16,630	20,337	23,102
Secondary	13	63	95
Titanium, ilmenite concentrate, gross weight	--	200	--
Tungsten concentrate:			
Gross weight	3,441	3,976	4,276
Metal content	1,637	1,892	2,035
Zinc:			
Mine output, metal content	3,220	--	--
Metal, unwrought ingot	66	71	--
Zirconium, gross weight	383	55	--
NONMETALS			
Asbestos	--	15	4
Barite	258,387	151,343	118,466
Cement, hydraulic thousand tons	[r]3,996	4,464	5,100
Clays:			
Ball clay	--	3,274	720
Kaolin[1]	15,782	16,660	24,810
Diatomite	--	--	190
Feldspar	13,025	12,257	17,619
Fertilizer materials:			
Crude phosphatic	5,805	7,250	3,100
Manufactured	153,273	NA	NA
Fluorspar:			
Crude mine production:			
High grade	174,918	128,529	193,315
Low grade	111,231	71,835	46,490
Total	286,149	200,364	239,805
Salable product:			
Acid grade (beneficiated low grade)	69,519	44,897	29,056
Metallurgical grade	174,918	128,529	193,315
Total	244,437	173,426	222,371
Graphite	30	30	23
Gypsum	255,242	267,822	330,090
Salt, rock[e] thousand tons	160	160	165,000
Sand, silica	34,310	24,145	112,168
Stone:			
Calcite	--	590	75
Dolomite	20	30	3,370
Limestone thousand tons	--	493	706
Marl (used for cement) do.	468	435	585
Quartz, not further described	11,330	3,563	34,520
Shale	--	74,504	180,696
Sulfur, sulfuric acid	38,000	NA	NA
Talc and related materials:			
Pyrophyllite	10,300	5,787	9,851
Talc	347	770	517
MINERAL FUELS AND RELATED MATERIALS			
Coal, lignite thousand tons	[r]463	680	439
Petroleum:			
Crude thousand 42-gallon barrels	[e]42	57	103
Refinery products:			
Gasoline do.	6,004	9,332	13,317
Jet fuel do.	4,710	7,673	4,732
Kerosine do.	842	976	1,761
Distillate fuel oil do.	13,596	15,835	17,591
Residual fuel oil do.	17,512	17,748	17,787
Other:			
Liquefied petroleum gas do.	2,152	2,590	1,333
Naphtha do.	2,367	1,811	--
Asphalt do.	589	783	984
Unspecified do.	5,265	11,370	--
Refinery fuel and losses do.	403	389	3,245
Total do.	53,440	68,507	60,750

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]Excludes kaolinite clay reported as follows in tons: 1975—none; 1976—3,360; 1977—1,160.

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TRADE

The value of trade in 1977 totaled over $8 billion, an increase of more than 21% over 1976 figures. Exports in excess of $3.5 billion were offset by imports of over $4.5 billion, resulting in a balance of trade deficit of more than $1 billion. This was an increase in the deficit of about 68% over 1976. Japan was again the major market for Thai exports, but taking only 20% of the total, a significant decline from the 26% in 1976. The Netherlands, United States, and Singapore followed with 13%, 9%, and 7%, respectively.

Agricultural products were the major foreign exchange earners, accounting for over 60% of total exports. In 1977, rice exports alone were a record 2.8 million tons and were valued at about $675 million or 19% of total exports.[5] Tapioca, sugar, and rubber also contributed over $300 million each in value. Poor weather conditions during the 1977-78 crop season will bring an estimated 10% smaller rice harvest. As a result of this and lower reserve stocks, restraints were imposed on 1978 rice exports. The Government lowered its 1978 rice export forecast to a conservative 1.2 to 1.4 million tons. The drought conditions also affected other farm products and no substantial increase in other agricultural exports is likely in 1978.

Mineral trade was generally good for the year. Encouraged by high world prices for tin and tungsten, Thailand exported minerals and metals worth about $320 million in 1977. Of this total, tin accounted for about $246 million. Other major exports were tungsten, fluorite, and cement. The gross value of precious stones exports ranked second, but much of this value was from the cutting and polishing of imported rough stones. Overall, minerals ranked fourth as a major export, coming between sugar and rubber in value.

Thailand's major imports, in descending order, were machinery, mineral fuels and lubricants, manufactured goods, and chemicals. Nearly one-third of total imports came from Japan, with the United States, Saudi Arabia, and the Federal Republic of Germany supplying 13%, 8%, and 6%, respectively. These countries have supplied the same relative proportions of Thailand's major imports during the last 3 years. The value of mineral fuels accounted for over 22% of total imports, a figure that also has remained relatively constant since 1974.

Table 2.—Thailand: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum:		
Metal including alloys:		
Unwrought	99	--
Semimanufactures	21	692
Antimony:		
Ore and concentrate	4,788	6,017
Metal including alloys, unwrought	156	227
Columbium and tantalum, ore and concentrate	20	123
Copper metal including alloys, all forms	r10	3
Iron and steel metal:		
Pig iron, ferroalloys, similar materials	57	--
Steel, primary forms	r22	559
Semimanufactures	r13,385	20,076
Manganese ore and concentrate	r821	1,234
Silver metal including alloys, all forms troy ounces	624,592	932,370
Tin metal including alloys, unwrought	r16,661	20,048
Titanium oxides	58	8
Tungsten ore and concentrate	3,382	--
Zinc:		
Ore and concentrate	19,000	--
Oxide	108	25
Metal including alloys:		
Scrap	220	--
Semimanufactures	29	343

See footnotes at end of table.

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Table 2.—Thailand: Exports and reexports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS —Continued		
Zirconium ore and concentrate	50	--
Other:		
Ores and concentrate	r1,520	5,475
NONMETALS		
Abrasives, grinding and polishing wheels and stones	r1	20
Asbestos	r503	2,170
Barite	188,584	107,186
Cement	729,128	633,286
Clays and clay products:		
Crude:		
Fuller's earth, dinas, and chamotte	--	51
Kaolin	1,002	--
Products:		
Refractory	1,873	2,612
Nonrefractory	809	942
Diamond, gem, not set or strung carats	238	146
Feldspar, leucite, nepheline, nepheline syenite	962	221
Fertilizer materials:		
Crude and manufactured:		
Potassic	(1)	--
Other and mixed	--	18
Ammonia, anhydrous	9	1
Fluorspar	211,699	284,287
Gypsum	92,587	66,289
Precious and semiprecious stones, except diamond:		
Natural:		
Precious thousand carats	r6,059	14,458
Semiprecious kilograms	148,413	NA
Manufactured do	52	586
Salt	116,161	90,002
Sodium and potassium compounds	514	5
Stone, sand, and gravel:		
Gravel and crushed rock	20	(2)
Limestone	r54	--
Sulfur, colloidal	20	40
Quartz and quartzite	3,154	14,903
Other slag, dross and similar waste, not metal bearing, n.e.s.	4,630	5,448
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	1,151	50
Carbon black	1	1
Coal briquets	1	1
Petroleum refinery products:		
Gasoline, motor and aviation thousand 42-gallon barrels	260	3
Kerosine do	353	224
Jet fuel do	76	105
Distillate fuel oil do	r55	--
Residual fuel oil do	r4	--
Lubricants do	8	9
Mineral jelly and waxes do	17	--
Other:		
Liquefied petroleum gas do	14	75
Unspecified petroleum gas do	r14	15

rRevised. NA Not available.
[1]Revised to none.
[2]Less than 1/2 unit.

Table 3.—Thailand: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum:		
Bauxite and concentrate	6,804	3,086
Oxide and hydroxide	3,764	1,747
Metals, including alloys:		
Scrap	97	1,006
Unwrought	18,434	28,872
Semimanufactures	4,269	3,906
Antimony:		
Ore and concentrate	21	38
Metal including all forms	(1)	(1)

See footnotes at end of table.

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Table 3.—Thailand: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS —Continued		
Arsenic trioxide, pentoxide, acids	12	72
Cadmium metal including alloys, all forms	1	(1)
Chromium, oxide and hydroxide	187	275
Cobalt:		
Oxide and hydroxide	2	249
Metal, including alloys, all forms	(1)	(1)
Copper:		
Matte	72	5
Copper sulfate	69	69
Metal including alloys:		
Scrap	631	393
Unwrought:		
Blister copper and other unrefined copper	458	(1)
Refined, unalloyed	2,202	2,845
Master alloys	7	1
Semimanufactures	6,635	5,581
Gold metal, unworked or partly worked, troy ounces	2,244	4,662
Iron and steel:		
Metal:		
Scrap	257,187	275,609
Pig iron, ferroalloys, similar materials	6,232	5,678
Steel ingots and other primary forms	r1,898	162
Semimanufactures	r552,348	886,054
Lead:		
Oxide	458	897
Metal including alloys:		
Scrap	441	172
Unwrought	7,778	7,584
Semimanufactures	119	46
Magnesium:		
Oxide	43	21
Metal including alloys:		
Unwrought	1	2
Semimanufactures	(1)	(1)
Manganese:		
Ore and concentrate	185	4,838
Oxides	425	(1)
Mercury, 76-pound flasks	61	216
Molybdenum metal including alloys, all forms	(1)	(1)
Nickel:		
Matte, speiss, similar materials	3	39
Metal including alloys:		
Scrap	(1)	--
Unwrought	29	18
Semimanufactures	216	373
Platinum-group metals including alloys, all forms, troy ounces	1,318	3,150
Silver metal including alloys	r2	--
Tin:		
Oxides	(1)	30
Unwrought	3	3
Semimanufactures	20	7
Titanium:		
Ore and concentrate	--	--
Oxide	1,446	3,269
Tungsten metal including alloys, all forms	4	4
Zinc:		
Oxide	209	275
Metal including alloys:		
Scrap	r1,000	278
Powder and dust	1	23
Unwrought	18,501	20,353
Semimanufactures	84	86
Other:		
Ore and concentrate of base metals, n.e.s	7,751	13,318
Metals including alloys, all forms:		
Alkali, alkaline earth, rare-earth metals	(1)	(1)
Pyrophoric alloys	19	45
Base metals including all forms, n.e.s	16	2
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, etc	2,296	2,836
Dust and powder of precious and semiprecious stones, kilograms	3	5
Grinding and polishing wheels and stones	1,083	1,040
Asbestos	43,024	56,748
Barite and witherite	4	16

See footnotes at end of table.

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Table 3.—Thailand: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS —Continued			
Bromine:			
Elemental	kilograms	--	
Compounds, n.e.s.		43	46
Cement		358	439
Chalk		551	801
Clays and clay product:			
Crude:			
Fullers earth, dinas, chamotte		3,666	4,970
Kaolin		2,546	6,844
Products:			
Refractory (including nonclay brick)		10,299	4,566
Nonrefractory		r1,209	1,956
Diamond:			
Gem, not set or strung	carats	3,068	31
Industrial	do.	--	18,990
Diatomite and other infusorial earth		5	21
Feldspar, leucite, nepheline syenite		841	1,422
Fertilizer materials:			
Crude and manufactured:			
Nitrogenous		86,369	210,959
Phosphatic		900	1,815
Potassic		25,980	12,450
Other including mixed		312,083	395,785
Ammonia, anhydrous		234	325
Fluorspar		13	125
Graphite, natural		1,217	--
Gypsum, anhydrite, plasters		292	316
Iodine		r(1)	(1)
Lime		130	154
Magnesite		3,998	4,356
Mica		46	44
Pigments, minerals, including processed iron oxides		r759	1,023
Precious and semiprecious stones, except diamond:			
Natural	kilograms	r293,162	262,407
Manufactured	do.	3,293	6,504
Salt		149	211
Sodium and potassium compounds		2,323	8,597
Stone, sand and gravel:			
Dimension stone:			
Crude:			
Calcareous (marble)		--	126
Slate		20	--
Other		404	483
Worked:			
Calcareous (marble)		r1,226	2,140
Slate		r92	267
Paving and flag stone		3	5
Other		211	148
Dolomite, chief refractory grade		29	13
Gravel		755	597
Limestone (except dimension)		--	2
Quartz and quartzite		279	634
Sand excluding metal bearing		708	47
Sulfur:			
Elemental:			
Other than colloidal		38,935	2,334
Colloidal		145	29
Sulfur dioxide		1	64
Sulfuric acid		117	73
Talc and steatite		3,619	7,366
Other nonmetals:			
Crude		1	(1)
Slag, dross, and similar waste, not metal bearing		1,864	550
Oxides and hydroxides of barium, magnesium, and strontium		3,642	38
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		5	3
Carbon black		8,234	10,533
Coal all grades, including briquets		4,566	4,154
Coke and semicoke		29,674	32,610
Petroleum:			
Crude and partly refined:			
Crude	thousand 42-gallon barrels	42,815	49,102
Partly refined	do.	9,786	6,278
Refinery products:[2]			
Gasoline:			
Aviation	do.	179	86
Motor	do.	386	2,898

See footnotes at end of table.

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Table 3.—Thailand: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum —Continued			
Refinery products[2] —Continued			
Kerosine	thousand 42-gallon barrels	43	13
Jet fuel	do.	127	101
Distillate fuel oil	do.	r4,708	5,107
Lubricants	do.	404	500
Other:			
Liquefied petroleum gas	do.	23	217
Mineral jelly and wax	do.	53	64
Nonlubricating oils, n.e.s	do.	320	420
Bitumen and others	do.	8	8
Bituminous mixtures, n.e.s	do.	1	1
Pitch, pitchcoke, petroleum coke	do.	129	8
Unspecified	do.	15	4
Total	do.	r6,396	9,427
Mineral tar and other coal, petroleum, or gas-derived crude chemicals		439	618

rRevised.
[1]Less than 1/2 unit.
[2]Includes bunkers.

COMMODITY REVIEW

METALS

Antimony.—Production of antimony dropped nearly one-third in 1977, to about 5,800 tons of 60% concentrate. Antimony metal output fell even more to less than 160 tons, or one-third of the 1976 level. The 4,000 tons of concentrate exported was estimated to value less than $4 million in 1977. An additional 60 tons of refined metal was also exported.

The lower world prices for antimony during the year were probably the main cause of the production slump. Most of Thailand's antimony is mined in small-scale manual operations that are highly sensitive to price fluctuations. When the price gets too low the diggings are simply closed until prices recover. Employment went from 2,180 persons in 44 antimony mines during December 1976, to a low of 1,280 persons in 23 active mines in November of 1977. At year-end, the employment figure increased modestly to over 1,700 in active mines.[6]

Iron and Steel.—Iron ore production, while more than doubling in 1977, was still of little actual significance in the mineral production of Thailand. About 63,000 tons of ore were produced and consumed locally in a small blast furnace at the Siam Iron & Steel Co. Ltd.'s plant. Five plants in the country have smelting capability and 24 firms have rerolling mills. The five smelters produce bars, wire rod, and sections for the construction industry. The rerolling mills have a combined capacity of about 300,000 tons per year of bars.[7]

Plans for the construction of a direct reduction sponge iron plant continued to be discussed in industry and Government circles. The discovery of natural gas in the Gulf of Thailand changed the plans for using lignite as the reductant. A Government committee selected an Austrian consultant firm to study the feasibility of setting up a direct reduction plant using natural gas as both the fuel and reducing agent. The study was begun in November and was expected to be completed early in 1978.

The Government would like to see some sort of integrated steel production based on local minerals and fuels. Thailand presently consumes over 1 million tons of steel per year, almost all of which is imported either as semimanufactures, scrap, or ingots.

The Government planned to continue surveying the central and eastern provinces for additional iron ore reserves. Thailand's present iron ore reserves are placed at about 40 million tons in scattered small deposits.

Tin.—Thailand's most valuable mineral commodity continued to be tin during 1977. Total production of 73% concentrate from all mining methods was reported at over 33,000 tons, an 18% increase over 1976. The smelting of the concentrate by the Thaisarco plant at Phuket produced about 23,000 tons of metal, more than 10% of world

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production. The production was valued at about $250 million, an increase of 66% over 1976, a result of the large increases in world tin prices. In addition to the reported production, up to 5,000 tons of tin concentrates may have been smuggled out of Thailand during 1977 to avoid payment of Government royalties.

A breakdown of mining methods showed that gravel pumping still predominated but was steadily losing ground to other techniques. Offshore dredging should show a sizable increase in the next few years. Tin-mining methods and output by type of operation in Thailand, in metric tons and percent of annual production, follows:

Type of mining operation	1973		1974		1975		1976		1977	
	Quantity	Percent[1]	Quantity	Percent[1]	Quantity	Percent[1]	Quantity	Percent[1]	Quantity	Percent[1]
Gravel pumping	10,070	48	9,189	45	7,767	47	7,958	39	8,219	34
Suction boat	--	--	--	--	--	--	4,682	23	6,346	26
Dredging:										
Inland	2,328	11	2,116	10	1,946	12	1,905	9	1,693	7
Offshore	3,821	18	4,520	22	3,048	19	1,484	7	3,210	13
Dulung washing	992	5	948	5	964	6	1,020	5	1,255	5
Ground sluicing	1,960	9	1,748	9	1,119	7	1,182	6	1,095	5
Hydraulicking	292	1	376	2	269	2	208	1	71	(2)
Others	1,458	7	1,442	7	1,293	8	2,014	10	2,316	10
Totals	20,921	100	20,339	100	16,406	100	20,452	100	24,205	100

[1]May not total 100% because of independent rounding.
[2]Less than 1%.

Source: Department of Mineral Resources, Thailand, 1968, p. 17.

Billiton Thailand Ltd., which bought out the old TEMCO holdings and equipment, signed a 5-year contract with the Government's Offshore Mining Organization (OMO) to dredge in Phangnga Bay off Phuket. The final agreement called for a sliding scale arrangement in which Billiton's revenue goes from 68.75% of the first 1,300 tons of tin produced per year, down to 40% of all over 1,700 tons per year. Operations began in January 1977. The big *NARAI* dredge (formerly *TEMCO II*, the world's largest suction-cutter dredge) was expected to produce about 1,500 tons of tin-in-concentrate during the year.

The Government introduced a new sliding scale tin royalty schedule effective July 15, 1977, designed to increase Government revenue in light of the marked world price increases in tin. The royalty increases were not popular with the industry. Also, the royalty increases fell heavily on the Government's own OMO because of the contract terms with Billiton. The higher payments made the already widespread smuggling of tin concentrate even more attractive to the smaller or marginal mine operators. By yearend, the Government was reportedly reviewing the situation and an announcement of a lowering of the rate was expected in January 1978.

In an effort to encourage more tin mining, the OMO signed a 5-year contract toward the end of the year, with Sethasap Karn Rae Co., a Thai firm, to operate two 270-ton-per-year bucket dredgers off the west coast of Phangnga Province. The sliding scale contract conditions were a little stricter than with Billiton. The company will receive from 58.15% to 44.15% of the receipts from the ores mined, depending on the Malaysian tin price. OMO receives the remainder and is to pay royalty from its share.

In December 1977, the Thai Cabinet was reportedly ready to approve an OMO proposal to purchase and operate directly an $18 million deepwater dredge from a Netherlands firm. Actual construction will probably be done in Singapore. Through direct operation by OMO, and not through a contractor, the Government would increase revenue considerably and also allow a tighter control of the offshore mining operations.

In an effort to lower transportation costs from the tin-mining areas north of Bangkok, the Department of Mineral Resources issued licenses for construction of three new small smelters near Bangkok. In the past, all tin for export was by law required to be smelted at the Thaisarco smelter at Phuket. The other two smelters in Thailand are small, 5 tons per month capacity, and cannot meet international quality standards.

The new licensees were: (1) Thailand Present and Smelting Co, Ltd. (Thaipasco),

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reportedly in Nakhon Pathom about 55 kilometers west of Bangkok, capacity at least 3,600 tons per year; (2) Thai Pioneer Enterprise Co. at Amphoe Bang Kradi near Pathum Thani in Pathum Thani Province, capacity 3,600 tons per year; and (3) Mr. Suchin Sadcharnong, Bangkok, capacity 360 tons per year. Construction began during the year on the $3.7 million Thaipasco project, a joint venture reportedly by Thai, Swiss, and Federal Republic of Germany firms. Reported financing difficulties may delay or cancel plans for the other two smelters.

Tungsten.—Tungsten has been Thailand's second most valuable mineral since 1972, when it surpassed the value of fluorite mined. Production of tungsten concentrate increased about 7% during 1977, to 4,276 tons, ranking Thailand about fifth in the world among market economy nations. The value, however, reflecting the year's higher prices, increased about 50% to around $45 million. Exports of tungsten were in the form of scheelite and wolframite concentrates and were roughly equal to the amount produced, since there were no chemical processing facilities in the country. As in the tin industry, a considerable amount of tungsten concentrate was smuggled out of the country to avoid payment of the taxes.

There were 17 tungsten lode mines in operation at yearend 1977, and 197 tin-tungsten placer mines. Much of the country's tungsten was produced in conjunction with tin placers. Over 600 people were employed in tungsten lode mining. About 6,200 additional workers were counted as tin miners but they contributed up to 40% of the tungsten output.

Uranium.—Thai Government sources reported the discovery of uranium ore deposits about 390 kilometers northeast of Bangkok. At least 20 drill holes in Khon Kaen Province intersected uranium occurrences well above the minimum required for commercial ore. The tonnages available have not been determined but drilling is continuing. Another discovery was also reported northeast of the first but in a remote jungle-covered area that made prospecting more difficult. The nature of the geologic formations in the deposits is similar to the Colorado Plateau uranium deposits in the United States.

If these deposits prove to be commercially exploitable, their discovery could be an important factor in the Government's long-studied plan to build a 600-Mw nuclear powerplant at Ao Pai in Chon Buri Province. The Government's consideration of a nuclear powerplant has been extremely controversial and each new Government that comes to power must consider the advantages and disadvantages of this extremely expensive and politically sensitive project.

Zinc.—After years of planning, research, negotiations, and delays, the Thai Zinc Ltd., a subsidiary of New Jersey Zinc Co., finally signed a contract on July 18, 1977, with the Thai Government, permitting the construction of an electrolytic zinc refinery, and mining of the rich zinc ores. Capacity of the refinery was to be at least 40,000 tons per year.[8] It will be located at the provincial capital of Tak (16°52'N, 99°08'E) in northwest Thailand. The ores, containing smithsonite and hemimorphite, will be mined at Mae Sot (16°40'N, 98°40'E), 70 kilometers west of Tak and only a few kilometers from the Burmese border. New Jersey Zinc Co. built a pilot plant at its research facilities in Palmerton, Pa., to test the complicated leaching cycle needed to economically refine the 25% zinc content ore.[9]

Despite the contract signing, construction of the refinery was not likely to begin soon. A land ownership problem was encountered in November 1977. Thai Zinc Co. filed a civil suit in Bangkok on November 7 to obtain title to the 400 hectares of land the refinery was to be constructed on. The land had been purchased for Thai Zinc Co. by a third party in 1973 at a time when the company did not have the right to own land. Also, terms of the contract with the Department of Mineral Resources state that Thai Zinc Co. had 6 months to arrange financing for the project and 30 months to complete the work. At yearend, little progress had been made toward the financing and it was rumored that the Whashin Industrial Corp. of the Republic of Korea, the proposed prime contractor for the refinery, was interested in financing the project as well.

Total cost of the project would be over $100 million and the cost of just the refinery was set at about $40 million.

NONMETALS

Barite.—Production of barite dropped in 1977 to under 120,000 tons valued at over $5.5 million. The decline in production was again due to a lack of demand for drilling and in the oil exploration industry in South-

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east Asia.

Cement.—The cement industry operated at 99% of rated capacity in 1977. Just over 5 million tons was produced, a 14% increase over 1976. The Board of Investment (BOI) announced it would accept applications for new plants to increase production by not less than 1.6 million tons per year by 1981, and by a similar amount by 1983. Minimum plant size per application was to be 800,000 tons per year and Thai shareholding of not less than 60% was required.[10] Because of the high domestic demand, exports of portland cement dropped to 292,000 tons in 1977. Indonesia, United Arab Emirates, and Hong Kong received over two-thirds of the total cement exports. The demand increased during the year and finally, on November 30, 1977, the Ministry of Commerce, in order to alleviate the growing shortage, prohibited all exportation of cement. It was necessary to import foreign cement toward yearend and the Foreign Trade Department forecast that these imports would increase steadily to about 1.2 million tons per year by 1980. Imports of 210,000 tons of cement were authorized by the Ministry of Commerce for 1978. In light of a proposal to build a deepwater port, a new airport, and the gas pipeline project, the projected cement demand could be much higher than Government's estimate of 6.8 million tons in 1980.

Fluorite.—Two applications were made at yearend to the BOI to open new fluorite mines. One was to be at Amphoe Khlong Thom, in Krabi Province and have a 30,000-ton-per-year capacity of chemical grade fluorite. The other application was to engage in mining or dressing of ore to produce annually, 12,000 tons of metallurgical-grade, 60,000 tons of low-grade, and 90,000 tons of crushed low-grade fluorite. The plant would be located at Amphoe Mae Tha, in Lamphun Province. Proposed employment for the two projects would total over 180 persons. Submission of the application to the BOI does not assure the startup of a given project.

Overall, crude fluorite production rose about 20% in 1977. Production of salable metallurgical grade reached 193,000 tons and 29,000 tons of acid grade flourite was also produced. A total of 242,000 tons of all grades valued at over $11 million was exported. This was the first reversal of the downward spiral that began after the 1974 peak year production of over 428,000 tons.

The Thai fluorite industry was highly dependent on the Japanese steel industry for its major market. The effects of the slump in world steel production, a steady reduction in the amount of fluorite used per ton of steel produced in Japan, and because Japan now buys its fluorite from a variety of sources, combined to cause the severe reduction in Thai export sales. The 1977 increase reflects Thailand's determination to diversify its markets as widely as possible. Some of the recent customers include the U.S.S.R., Poland, Taiwan, the Republic of Korea, the Netherlands, and the United States.

Other.—During 1977 the Asian Development Bank financed a detailed economic feasibility study of the proposed soda ash (Na_2CO_3) plant on the Khorat Plateau in northeastern Thailand. The findings will be presented to the Thai Government in mid-1978. The project would utilize the large reserves of very pure salt and nearby limestone. However, to make the project economically viable, a deepwater port, probably at Laem Chabang southeast of Bangkok and about 160 kilometers of new railroad spur lines would be required. The present transportation system between the deposits and the Gulf of Thailand is incapable of handling the large tonnage of materials that would be required.

In 1972 and 1974 the soda ash project proposal met with considerable local opposition when foreign companies showed an interest in development. In 1976, the Government proposed this as a regional project of the Association of Southeast Asian Nations (ASEAN), in which ASEAN partners as well as private investors will be invited to take an equity interest. Estimated cost of the project would be $160 million, not counting the needed infrastructure improvements.

The Department of Mineral Resources (DMR) continued its potash exploration program in 1977, finding additional large deposits of carnallite ($KMgCl_3.6H_2O$) and highly promising deposits of sylvite (KCl) in the Cretaceous evaporite basins of northeastern Thailand. In October 1977, the DMR reportedly invited a number of companies to submit proposals for further exploration and eventually the development of the deposits.[11]

MINERAL FUELS

Lignite.—The lignite mine at Mae Moh was being mechanized and expanded during

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1976 and most of 1977. The project, managed by a group of West European firms for the Electricity Generating Authority of Thailand, was designed to furnish a reliable and inexpensive source of fuel to the onsite thermoelectric powerplant. The plant was designed in 75-Mw units. The first unit was reportedly completed in September 1977, and the second unit was scheduled for an August 1978 startup. Two more units are planned for 1981-83.[12] Power generation remains the major end use of Thailand's lignite production. A small amount was supplied to the State-owned Chemical Fertilizer Co. Ltd.

Lignite production was nearly 440,000 tons during 1977, a 35% drop from 1976. The lower production was probably because of the construction work at Mae Moh.

Oil Shale.—Detailed surveying of the shale oil deposit at Mae Sot was begun in February 1974 and continued until May 1977. Over 180 diamond drill holes were sunk to delineate the deposits. The survey was not complete but there is little chance of the Government beginning exploitation of these deposits, regardless of the reserves, considering the imminent development of the natural gas deposits in the Gulf of Thailand.

Natural Gas and Petroleum.—On March 9, 1977, the Thai Government officially announced the formation of the Natural Gas Organization of Thailand (NGOT). The new organization was responsible for the development, production, transportation, storage, purchase, sale, and distribution of natural gas in Thailand. NGOT thus became the authority over virtually all activity connected with natural gas, from granting of exploration licenses to determining its end use.

The three major natural gas strikes made in 1976, were supplemented by two more successful wells in 1977, both by the Texas Pacific Thailand Inc. consortium (Texas Pacific). The Union Oil Co. of Thailand Ltd.'s (Union Oil) reserves are placed at over 1 trillion cubic feet (28 billion cubic meters) and Texas Pacific's reserves are estimated at over 3.4 trillion cubic feet (96 billion cubic meters). At yearend AMOCO was drilling in block 5 for scheduled well completion in early 1978.

Union Oil and NGOT continued the protracted negotiations on pricing of the natural gas discovered in blocks 12 and 13. Although both sides were anxious to sign a contract, each felt the other's price was unreasonable. No construction will begin until the talks result in a firm contract. Despite the impasse, which may continue well into 1978, the NGOT has hired consultants to evaluate sea and seafloor conditions along the proposed pipeline route from the gas deposits to Bangkok. Tentative alinement of the pipeline would be approximately north for about 400 kilometers to landfall near Rayong east of Sattahip. The line will then be laid overland an additional 160 kilometers to Bangkok.

Overall cost of developing the gasfield, laying the off- and onshore pipelines, and building the gas processing plant was estimated at between $500 million and $600 million. This price would not include the cost of developing the Texas Pacific discoveries that would be funded separately.

The Texas Pacific gasfield in blocks 15 and 16 lies roughly 190 kilometers southeast of the Union Oil fields. The bulk of the natural gas consumption will be in the Bangkok area, so the Government planned to bring the gas to market by connecting with the Union Oil pipeline. Texas Pacific will face the same gas pricing negotiations that Union Oil and NGOT are engaged in. It was assumed, however, that once the first settlement is completed, the terms of the Texas Pacific contract would be similar and the contract should be signed without much additional delay.

Domestic oil production was economically insignificant and totaled about 280 barrels per day, and was processed locally at the 1,000-barrel-per-day Fang refinery near Chieng Mai.

The country's three large refineries, totaling 165,000-barrels-per-day capacity, operated entirely on imported petroleum. Imports of crude oil and topped crude oil to these refineries totaled about 9.7 million kiloliters (61 million barrels) at a cost of over $820 million.[13] The main source of imports continued to be the Persian Gulf countries, with Saudi Arabia, Qatar, and Kuwait supplying nearly 84% of Thailand's crude oil needs.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from the Thai baht (B) to U.S. dollars at the rate of B20-US$1.00.

[3]Business Review, Bangkok, Thailand. V. 6, No. 3, April 1978, pp. 197-198.

[4]U.S. Embassy, Bangkok, Thailand. Department of State Airgram A-96, June 29, 1978, pp. 1-9.

[5]Bank of Thailand. Monthly Bulletin, Bangkok, Thailand. V. 17, No. 3, March 1978, pp. 39-57.

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[6]Mineral Resources Gazette, Bangkok, Thailand. V. 23, No. 4, April, 1978, pp. 98-99.
[7]U.S. Embassy, Bangkok, Thailand. Department of State Airgram A-120, May 17, 1977, p. 3.
[8]U.S. Embassy, Bangkok, Thailand. Department of State Telegram, Bangkok 15779 190857Z, July 1977.
[9]Wood, J.T., P.L. Kern, and N.C. Ashdown. Electrolytic Recovery of Zinc from Oxidised Ores. J. Met., November 1977, pp. 7-11.
[10]Bank of Thailand. Monthly Bulletin, Bangkok, Thailand. V. 18, No. 3, March 1978, pp. 49-51.
[11]Phosphorous and Potassium. Thailand Potash Potential. No. 92, November-December 1977, pp. 44-45.
[12]U.S. Embassy, Bangkok, Thailand. Department of State Airgram A-91, June 8, 1978, p. 6.
[13]U.S. Embassy, Bangkok, Thailand. Department of State Airgram A-103, July 21, 1978, pp. 1-11.

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The Mineral Industry of Tunisia

By E. Shekarchi[1]

Production of phosphate rock in Tunisia, the third largest producer among market economy countries, was in the hands of Cie. des Phosphates de Gafsa (CPG), which operated eight mines, seven of them in the Gafsa basin. Total sales of phosphate rock reached 3.7 million tons in 1977, compared with 3.5 million tons in 1976. The increased demand was largely from the domestic market, which used an additional 175,000 tons in 1977. Production of other minerals such as fluorite, barite, iron, lead-zinc, silver, and marine salt contributed significantly to the otherwise agrarian economy of Tunisia. The preliminary gross domestic product (GDP) for 1977, based on current prices, was estimated at $4.9 billion, an increase of 11% over the 1976 GDP. Per capita GDP increased 8% to about $825 from $762 the previous year.

The fifth development plan (1977-81) was initiated during the year with the following goals: To reach self-sustaining economic growth free from dependence on external assistance, to provide a job for each new entrant into the labor force in 1981, and to maintain an annual real growth of 7.5%. Total industrial investment, including energy and mining, was to be $7.8 million annually under the fifth plan. Four capital-intensive sectors were to receive the bulk of the financing — phosphates, fertilizers, chemicals, and electric power. The major industrial investment projects foreseen were a program to double output of phosphate rock, a new nitrogenous phosphate fertilizer plan, a third unit shifting the phosphate industry toward intermediate finished products, four new cement plants, and development of the Miskar offshore natural gas field. Gas, to be available by 1981 from the Algerian-Italian pipeline transiting Tunisia and from Miskar gasfield, was regarded as the energy key to industrial development and the means to reserve crude oil for export. Production of petroleum, the most important mineral industry both now and in the future, reached 90,000 barrels per day, and output was to increase to 120,000 barrels per day by 1981. Petroleum production was anticipated to increase further if offshore prospects materialize. The first steps were taken toward arbitration of an offshore boundary dispute between Tunisia and Libya, the settlement of which could be beneficial to both parties.

The Trans-Mediterranean gas pipeline, to carry 1,200 million cubic meters annually of Algerian gas through Tunisia and across the Mediterranean to Italy, came closer to reality during the year when strained relations between Algeria and Tunisia were finally relieved and Italy and Tunisia signed an agreement for construction of the pipeline. The pipeline was scheduled to be completed by 1980, and not only was it to supply Italy with natural gas for the next 20 years from Algerian fields, but Tunisia was also to receive a percentage of the natural gas instead of cash payments for royalties.

PRODUCTION AND TRADE

Available data on mineral production are given in table 1. Data on exports and imports are given in tables 2 and 3, respectively.

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Table 1.—Tunisia: Production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Iron and steel:			
Iron ore and concentrate, gross weight	616	495	344
Metal:			
Pig iron	[r]144	108	132
Steel, crude	129	103	156
Lead:			
Mine output, metal content—tons	10,916	10,364	10,249
Metal, primary, unalloyed[2]—do	[3]23,396	23,476	19,702
Mercury metal, primary—76-pound flasks	(4)	--	--
Silver metal, primary—thousand troy ounces	289	257	236
Zinc, mine output, metal content—tons	[r]7,104	7,345	7,081
NONMETALS			
Barite—do	14,900	23,400	16,049
Cement, hydraulic	[r]620	478	572
Clays, construction	255	195	NA
Fertilizer materials:			
Crude: Phosphate rock	3,512	3,301	3,615
Manufactured:			
Hyperphosphate	9	31	[e]40
Superphosphate	51	49	47
Triple superphosphate	304	346	489
Fluorspar, chemical-grade—tons	33,917	34,500	28,857
Gypsum—do	--	38,800	--
Lime, hydraulic	283	318	338
Salt, marine	420	288	405
MINERAL FUELS AND RELATED MATERIALS			
Gas:			
Natural:			
Gross—million cubic feet	19,400	15,891	[e]20,000
Marketed—do	7,497	7,554	6,710
Manufactured—do	[e]690	[e]700	NA
Petroleum:			
Crude—thousand 42-gallon barrels	35,532	28,600	34,675
Refinery products:			
Gasoline—do	1,118	1,104	1,199
Kerosine—do	650	833	791
Distillate fuel oil—do	2,541	2,415	2,536
Residual fuel oil—do	3,287	3,241	3,383
Other—do	748	649	957
Refinery fuel and losses—do	460	790	156
Total—do	8,804	9,032	9,022

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, a variety of crude construction materials (common clays, sand and gravel, and stone) is also produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2]From domestic and imported ores.

[3]Pig lead only (excludes lead content of antimonial lead).

[4]Revised to none.

Table 2.—Tunisia: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal including alloys, all forms	25	103	Belgium-Luxembourg 51; France 51.
Copper:			
Matte	[r]162	182	France 72; Hungary 61; Belgium-Luxembourg 29.
Metal including alloys, all forms	[r]121	543	Italy 255; Belgium-Luxembourg 195; France 48.
Iron and steel:			
Ore and concentrate	295,611	112,632	Belgium-Luxembourg 110,000.

See footnotes at end of table.

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Table 2.—Tunisia: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Iron and steel: —Continued			
Metal:			
Scrap	3,571	1,300	Italy 700; Switzerland 600.
Pig iron and ferroalloys	751	--	
Steel, primary forms	r2,164	--	
Semimanufactures	r4,284	766	Algeria 760.
Lead:			
Ore and concentrate	--	5,859	All to France.
Metal including alloys, all forms	r465	20,755	Italy 8,790; Greece 7,005; Algeria 3,125.
Silver metal including alloys ---troy ounces	83,592	161,139	France 128,989; United Kingdom 32,151.
Zinc:			
Ore and concentrate	8,195	15,586	Italy 8,766; Switzerland 4,000; France 2,820.
Metal including alloys	53	55	France 54.
NONMETALS			
Abrasives, natural	--	2	Libya 1.
Barite and witherite	5,000	4,000	All to Algeria.
Cement	1	(1)	All to Libya.
Chalk	568	164	Do.
Clays and clay products (including all refractory brick):			
Crude	137	15	All to Italy.
Products, nonrefractory	25,618	2,862	All to Libya.
Feldspar and fluorspar	12,050	16,670	All to Italy.
Fertilizer materials:			
Crude, phosphatic	r2,053,773	1,961,841	France 536,323; Turkey 295,588; Greece 278,372; Poland 274,480; Czechoslovakia 101,653.
Nitrogenous	--	878	Ireland 758; United Kingdom 119.
Phosphatic	r238,199	327,589	France 114,078; West Germany 56,540.
Mixed and other	r240,300	16,161	France 6,012; Spain 2,541; Italy 2,100.
Gypsum and plasters	1,366	150	All to Libya.
Lime	1	--	
Pigments, mineral, natural	r41	6	All to Libya.
Precious and semiprecious stones, except diamond ---kilograms	r21	423	All to Belgium- Luxembourg.
Salt and brine	197,710	267,490	Italy 55,609; Uruguay 42,000; Norway 36,540.
Stone, sand and gravel:			
Dimension stone, crude and partly worked	r399	35	West Germany 13; Italy 2.
Gravel and crushed rock	r(1)	17	West Germany 16; Italy 1.
Sand, excluding metal bearing	5	3	West Germany 1; Italy 1; Netherlands 1.
Sulfur: Sulfuric acid including oleum	11,193	--	
MINERAL FUELS AND RELATED MATERIALS			
Petroleum:			
Crude ---thousand 42-gallon barrels	36,692	28,421	Greece 8,450; United States 8,154; Italy 6,457; France 2,132.
Refinery products:			
Gasoline ---do---	2	--	
Kerosine ---do---	r923	483	Mainly to bunkers.
Distillate fuel oil ---do---	31	77	Do.
Residual fuel oil ---do---	186	194	Italy 150; bunkers 44.
Lubricants ---do---	2	7	Mainly to bunkers.
Other ---do---	r1	16	Italy 14; bunkers 2.
Total ---do---	r1,145	777	

rRevised.
1Less than 1/2 unit.

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Table 3.—Tunisia: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum metals including alloys:			
Unwrought	3	56	Canada 51.
Semimanufactures	r1,609	1,433	Italy 352; France 261; Belgium-Luxembourg 198.
Chromium oxide and hydroxide	11	14	West Germany 13; Netherlands 1.
Copper metal including alloys, all forms	r1,858	1,865	France 962; West Germany 316; Belgium-Luxembourg 185.
Gold metal, unworked or partly worked thousand troy ounces	32	20	Switzerland 17; France 2.
Iron and steel metal:			
Scrap	662	1,595	Ivory Coast 1,130; Cameroon 400; France 46.
Pig iron and ferroalloys	990	367	France 278; Netherlands 50.
Sponge iron, powder, shot	r73	64	France 58; Italy 5.
Steel, primary forms	6,731	15,307	France 5,861; Italy 5,551; Australia 1,223.
Semimanufactures	r130,010	153,056	France 63,488; West Germany 28,269; Belgium-Luxembourg 21,500.
Lead:			
Ore and concentrate	24,089	18,523	Morocco 13,614; Algeria 2,384; Switzerland 2,150.
Oxide	117	144	France 83; West Germany 59.
Metal including alloys, all forms	20	27	France 17; Belgium-Luxembourg 5; West Germany 3.
Magnesium metal including alloys, all forms	2	(1)	Mainly from Italy.
Mercury 76-pound flasks	440	5,887	Mainly from France.
Nickel metal including alloys, all forms	6	13	France 12; Italy 1.
Platinum-group and silver metals including alloys:			
Platinum-group troy ounces	418	257	France 193; West Germany 64.
Silver do	32,697	14,789	France 8,681; Italy 4,726.
Tin metal including alloys, all forms	92	73	Indonesia 24; France 14; Malaysia 15; Belgium-Luxembourg 10.
Titanium oxide	393	391	Italy 128; West Germany 109; France 94; Belgium-Luxembourg 40.
Zinc:			
Oxide	173	204	France 168; Belgium-Luxembourg 26.
Metal including alloys, all forms	1,009	1,086	France 422; Italy 175; Belgium-Luxembourg 120.
Other:			
Ores and concentrates,	(1)	1,650	All from Morocco.
Oxides, hydroxides, peroxides of metals	191	534	West Germany 364; France 77; United Kingdom 70.
Base metals including alloys, all forms	47	77	Belgium-Luxembourg 57; Italy 15.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	106	172	France 137; Italy 35.
Grinding and polishing wheels and stones	254	272	Italy 157; France 72.
Asbestos	1,619	1,474	Canada 911; Asia 150; France 150; U.S.S.R. 150.
Barite and witherite	4,949	8,924	Italy 3,713; Morocco 2,846; France 1,577; Greece 400.
Boron materials:			
Crude natural borates	42	7	Turkey 5; France 2.
Oxide and acid	181	61	Italy 50; West Germany 11.
Cement	527,353	792,951	Spain 302,149; U.S.S.R. 223,227; Yugoslavia 191,656.
Chalk	395	283	Mainly from France.
Clays and clay products (including all refractory brick):			
Crude	r18,701	11,032	United Kingdom 3,458; Morocco 2,628; France 1,428.
Products:			
Refractory	7,698	6,678	France 3,409; Morocco 1,205; West Germany 825.
Nonrefractory	24	1	All from West Germany.
Diatomite and other infusorial earth	r136	150	France 138.
Feldspar and fluorspar	800	750	Italy 500; France 250.
Fertilizer materials:			
Manufactured:			
Nitrogenous	80,974	71,030	Romania 24,901; Bulgaria 22,044; Poland 18,517.
Phosphatic	(1)	1	All from Netherlands.
Potassic	14,794	4,982	Mainly from Italy.
Other, including mixed	41	5	Mainly from West Germany.
Ammonia	194	6,224	Netherlands 5,501.
Graphite, natural	3	4	France 3; Algeria 1.
Gypsum and plaster	171	190	Mainly from France.

See footnotes at end of table.

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Table 3.—Tunisia: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Lime	(1)	9	Do.
Magnesite	5	6	United States 5; France 1.
Mica, all forms	r18	21	Mainly from France.
Pigments, mineral, including processed iron oxides	166	137	West Germany 104; France 18.
Pyrite, gross weight	5,000	(1)	All from France.
Salt and brine	2	9	France 5; United Kingdom 3; West Germany 1.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	r7,695	9,899	France 7,894; Spain 905.
Caustic potash and sodic and potassic peroxides	16	17	France 8; West Germany 6; Belgium-Luxembourg 2.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	7,794	9,517	Mainly from Italy.
Worked	r94	98	Italy 85.
Dolomite, chiefly refractory grade	121	37	France 27; Italy 10.
Gravel and crushed rock	6,512	7,744	Italy 7,338.
Quartz and quartzite	1,004	525	Mainly from Belgium-Luxembourg.
Sand, excluding metal bearing	30	104	Italy 60; Belgium-Luxembourg 30; France 13.
Sulfur:			
Elemental, all forms	178,982	388,387	Canada 156,892; Iraq 72,770.
Sulfuric acid, including oleum	1,162	664	France 566; Netherlands 77.
Talc, steatite, soapstone, pyrophyllite	2,597	1,591	France 982; Italy 603.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	1,731	55	Italy 49; France 5.
Coal, all grades, including briquets	52,919	23,229	France 5,722; U.S.S.R. 5,400; Morocco 4,768; Poland 4,470.
Coke and semicoke	87,027	84,977	West Germany 44,066; Italy 40,911.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	r7,522	8,550	Saudi Arabia 4,348; Iraq 4,123.
Refinery products:			
Gasoline do	3	(1)	All from West Germany.
Kerosine do	1,385	1,689	Greece 1,407; Italy 264.
Distillate fuel oil do	1,231	1,418	Italy 735; Greece 682.
Residual fuel oil do	220	339	Egypt 133; Venezuela 133; Romania 73.
Lubricants do	136	177	Italy 108; France 22; Romania 18.
Mineral jelly and wax do	r6	7	West Germany 3; Hungary 2; France 1.
Bitumen do	93	119	Italy 116.
Other do	r153	223	Italy 109; Greece 85.
Total do	r3,227	3,972	

rRevised.
1Less than 1/2 unit.

COMMODITY REVIEW

METALS

Iron and Steel.—Iron ore production from Djebel Djerissa Tamera, Douaria decreased to 343,000 tons in 1977 from 495,000 tons in 1976. Exports of iron ore declined to 102,000 tons in 1977 from 155,000 tons the previous year. The remainder of production was used indigenously, supplying the El Fouladh and Menzel Bourgiha steel mills. The expansion of the El Fouladh steel mill, by addition of a 30,000-ton-capacity electric arc furnace, was completed, and the company produced 464,000 tons of cast iron and steel in 1977.

Since easily retrievable deposits of hematite ore were about to be exhausted and most of the production was from iron-carbonate reserves, the Government made the decision that after 1978 no iron ore is to be exported. All operating mines in 1977 were underground and expensive to oper-

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ate; however, domestic production was more economically viable than importation of ore from abroad.

Lead and Zinc.—The Government-owned mining company Soc. Tunisienne d'Expansion Minière (SOTEMI) was the sole producer of lead and zinc ore in 1977. Lead concentrate continued its long decline, with output totaling only 16,500 tons in 1977, while zinc concentrate registered a gain to 13,000 tons.

Refined lead was exported to Greece (6,000 tons) and Italy (5,000 tons), and in small amounts to other European countries.

NONMETALS

Cement.—Cement production continued to receive national priority, and significant investments were made in 1977 and for the coming year. Tunisia produced 630,000 tons of cement in 1977 which was slated to increase to 930,000 tons in 1978 and 1.5 million tons in 1979. Demand for cement continued to grow in this rapidly developing country, and cement imports met 60% of demand in 1977. The planning organization set goals of reducing import dependence and becoming a net cement exporter by 1981.

Work on the cement plant in western Tunisia near the Algerian border continued, completion set for 1979. Work on a new cement plant in central Tunisia began in late 1977, and cement plants at Bizerte and Gabès produced at full capacity during 1977. Construction of the plant near Bizerte for asbestos cement products, primarily pipe, continued during the year at a cost of $10 million. The facility, expected to produce 26,000 meters of pipe for irrigation and sanitation purposes, was to go into production by the end of 1979. The plant was financed by a group of private investors under the name of Ciment-Amiante-Tunisia.

Fertilizer Materials.—In 1977, Tunisia produced 3.6 million tons of phosphate rock, a 9% increase over the 1976 output. The price of Tunisian phosphates on international markets, however, decreased 26% in 1977, accompanied by a slight decrease in the price of the superphosphates exported. For this reason, the 1977 foreign exchange earnings of phosphates remained at the 1976 level, although quantities exported increased. This price decline affected production projections for future years, as 4.1 million tons was forecast for 1978. The phosphate mining industry was concentrated in the Gafsa basin in south-central Tunisia. During 1977, there were eight mines operating in this basin, one opencast (Kef es Schfair) and seven underground, in which longwall and load-haul-dump mining techniques prevailed. Phosphate-processing plants were also centered in the Gafsa area, usually close to the mine and connected by State railways. In 1977, six phosphate rock washing plants were in operation, with four more expected to be online by mid-1980.

A phosphoric acid production plant was operated in Gabès by Industrie Chemique Maghrebines (ICM). The facility included a triple superphosphate plant and sulfuric acid plant. ICM used two long-term chartered tankers to export its product and processed 1 million tons of phosphate rock in 1977.

Tunisia continued its ambitious plan to double phosphate production to approximately 7 million tons between 1976 and 1981. By the end of 1977, it was apparent that this level of production will not be achieved by 1981 but could well be obtained by 1985. To achieve better coordination among various sectors of the phosphate mining and processing organizations, the Government proposed a new office, Groupment Public des Phosphates et Derives, to be established during the coming year. The chief responsibility of this office will be to bring together various phosphate company representatives with Government ministry representatives interested in mining and national planning.

The World Bank committed a loan of $23 million to assist Tunisia in doubling production of phosphate, and the Abu Dhabi Fund for Arab Economic Development provided investments of $189 million for the first stage of an ambitious program for six plants at Gabès, forecast to produce 170,000 tons of phosphoric acid and 330,000 tons of ammonium phosphate annually. Operation of the Gabès plant is to be managed by Soc. d'Engrais Phosphates et Azotes (SEPA) and involves two existing phosphoric acid producers at Gabès.

Other.—Fluorspar production decreased 16% in 1977. Unlike in previous years, most of the production was earmarked as feedstock for Industries Chemiques de Fluor's aluminum fluoride plant, which started full production in 1977. Barite, which has found limited use within the country, is associated with fluorite in the Zriba mine. Most of the barite had accumulated in the waste ponds. The only other nonmetals produced were

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lime, which increased 6% in 1977, and marine salt, which increased 41%.

MINERAL FUELS

Natural Gas.—Tunisia's energy plan through 1985 is principally based upon the use of natural gas for industrial and power projects, thus reserving crude oil for export. A decision was made in 1977 to proceed with development of the domestic offshore gasfield to meet domestic industrial needs. However, the successful revival of the project for a pipeline to transport Algerian gas across Tunisia and the Mediterranean Sea to Italy gave Tunisia another option, with negligible capital costs compared with the nearly $500 million estimated for Miskar. The gas-based energy policy remained unchanged and the Government contracted for drilling of the reserves and studies of the economic feasibility of this project.

Production of natural gas increased by about 116 million cubic meters in 1977. About 250 million cubic meters of total production was consumed by domestic industries for power generation and other industrial uses.

Petroleum.—While still small by world standards, Tunisia's petroleum production provided its largest source of foreign exchange and a domestic energy base for industrialization. As a result of secondary recovery programs in the two major Tunisian oilfields and small new producing areas onshore, Tunisia's output increased to 4.3 million tons in 1977 from 3.7 million tons the previous year. Annual consumption increased to about 1.8 million tons, which still left Tunisia with a large net trade surplus on the energy account. Development drilling in 1977 involved 13 wells. Of the 10 wells in the El Borma field, 7 were for production and 3 were for water injection. Two production wells were drilled in the Ashtart field and one in the Sidi El Itayem field west of Sfax. In 1977, there were a total of 12 wildcat wells, 11 of which were offshore. The upward trend in exploration activity was more clearly evident in geophysical work; 9,900 kilometers of seismic surveys were completed in 1977, compared with 4,000 kilometers in 1976. Wildcat drilling in 1977 resulted in two finds each of oil and combustible gas. At yearend, there were 17 active permits. The total area subject to exploration permits was 146,000 square kilometers, of which 71,000 was offshore.

Output of the country's only refinery at Bizerte was 1.22 million tons in 1977. Both economic and energy considerations made it more advantageous for Tunisia to export most of its own crude oil, importing 97% of its oil from Iraq and Saudi Arabia to fuel the Bizerte refinery. Petroleum pricing in Tunisia continued to be below the world market for all products except gasoline during 1977.

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[1]Supervisory physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Tunisian dinars (TD) to U.S. dollars at the rate of TD1 = US$2.33.

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The Mineral Industry of Turkey

By T. John Rowland, Jr.[1]

The mineral industry of Turkey directly contributed about 1% of the gross national product (GNP) of $46 billion[2] in 1977. According to estimates by the State Institute of Statistics, Turkey's GNP grew 5% in 1977; the highest growth rate was recorded by the industrial sector at 7%. Turkey's development plans give high priority to the mineral sector.

The lack of available usable energy is one of Turkey's fundamental economic problems. Turkey, a minor producer of petroleum, was deeply affected by the worldwide rise in oil prices in 1973. The proportion of oil imports to total domestic needs has increased sharply in recent years. In 1972, petroleum imports cost $124 million and constituted 7.9% of total imports, while in 1977 the cost of petroleum imports increased to $1.2 billion and accounted for 20% of import value. Turkey's plans are to develop lignite and hydroelectric resources to reduce its reliance on oil.

Investment in the mineral sector, including petroleum, was $418 million in 1977. The bulk (94%) of this investment went to public sector mines. Maden Tetkik ve Arama EnstitüSü (MTA) (Mineral Research and Exploration Institute), a State organization, was responsible for the full spectrum of mineral exploration activities from basic geological studies to the preparation of mining feasibility studies. MTA employed 2,000 technical and professional personnel with a budget of $120 million in 1977. Total planned expenditures by MTA for the period 1977-82 were allocated as follows, in million dollars:

Commodity	Expenditures
Base metals	117
Iron ore	97
Chromite	40
Ceramic and refractory raw materials	36
Phosphate	14
Bauxite	13

Mining activities in Turkey were legislated by Mining Law 6309, enacted in 1954, Petroleum Law 6324 of 1954, and the amended Petroleum Reform Law 102 of 1973. The Government owned all mineral resources and granted exploration and mining permits. Mining activities were conducted in Turkey by major State-owned economic enterprises such as Etibank Genel. Mudurlugu, Black Sea Copper Co., and Türkiye Komuleri Işletmesi (TKI) Turkish coal works and by private companies. A bill to nationalize the mining of boron, lignite, and some other important minerals was examined by the Government but had not been approved by Parliament by yearend.

During 1977, the Government introduced an economic stabilization program to reduce the Government's budgetary deficit. One of the major budgetary measures was an increase in the prices of products marketed by the State Economic Enterprises (SEE). This measure was to reduce SEE deficits, most of which were subsidized by Government revenues. Another important measure was an increase in the price of energy, including gasoline which nearly doubled in price. Before the September 9, 1977, increase, gasoline was selling at a

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lower price in Turkey than in any other European country.

PRODUCTION

Mineral production registered both gains and losses in 1977. Increases were evidenced in the production of bauxite, boron materials, copper ore, magnesite, perlite, and sulfur ore. Commodities registering declines included iron ore, pyrite, chromite, and mercury. The production of mineral fuels (lignite, bituminous coal, and petroleum) remained relatively stable compared with that of previous years.

Table 1.—Turkey: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Aluminum:			
Bauxite	[r]558,193	461,040	667,200
Alumina	81,708	138,732	[e]169,700
Metal	16,500	35,500	47,200
Antimony:			
Ore, mine output:			
Gross weight	[r]24,920	34,309	38,318
Metal content	[r]3,638	5,009	5,594
Regulus	[r]242	91	61
Chromite:			
Gross weight (34% to 43% Cr_2O_3)	[r]952,006	945,168	905,554
Salable product	450,000	440,000	490,000
Copper:			
Mine output, metal content	[r]25,874	[re]23,500	[e]26,800
Metal:			
Smelter	[r]26,952	28,104	31,619
Refined	[r]15,105	14,300	[e]15,000
Iron and steel:			
Iron ore, gross weight (thousand tons)	[r]2,359	3,605	3,304
Metal:			
Pig iron and ferroalloys:			
Ferrochromium[e]	9,500	10,000	10,000
Pig iron and other ferroalloys (thousand tons)	1,359	1,992	1,728
Crude steel (including castings) (do.)	1,457	1,457	1,397
Lead:			
Mine output, metal content[1]	[r]6,454	[re]6,470	[e]7,200
Smelter	[r]3,000	3,200	3,000
Manganese ore, gross weight	[r]35,023	33,783	33,715
Mercury (76-pound flasks)	5,310	4,899	4,509
Tungsten, mine output, metal content	[e]10	928	[e]1,000
Zinc, mine output, metal content[2]	[r]25,616	[re]42,750	[e]67,100
NONMETALS			
Abrasives, natural, emery	[r]71,912	67,342	64,488
Asbestos	[r]15,496	9,941	3,767
Barite	[r]66,254	188,266	133,347
Boron materials (thousand tons)	964	912	1,099
Cement, hydraulic (do.)	[r]10,855	12,342	13,833
Clays:			
Bentonite	32,656	23,560	4,357
Kaolin	34,535	55,611	59,162
Other	87,337	85,753	66,717
Diatomite	[e]8,000	8,500	9,000
Feldspar	[e]57,000	57,800	75,200
Fertilizer materials:			
Natural, phosphate rock	25,000	67,000	65,418
Manufactured:			
Ammonium nitrate	56,358	262,431	NA
Ammonium sulfate	125,946	162,335	NA
Superphosphates	962,825	854,614	NA
Ammonia, anhydrous	33,615	37,198	NA
Fluorspar	1,405	1,282	1,711
Gypsum	37,987	32,308	60,245
Magnesite, crude ore	[r]456,887	409,276	493,370
Meerschaum (kilograms)	[r]26,150	12,600	4,150
Perlite	11,927	24,546	30,000
Pyrite, cuprous, gross weight	23,640	84,630	38,300
Salt, all types (thousand tons)	[r]679	[re]680	[e]680
Sodium sulfate	80,431	87,907	72,917

See footnotes at end of table.

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Table 1.—Turkey: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
NONMETALS —Continued			
Stone, sand and gravel, n.e.s.:			
Limestone thousand tons	7,000	16,295	19,121
Marble	[r]175,000	113,700	118,600
Quartzite	157,540	196,276	188,603
Sand, siliceous	29,112	23,936	48,356
Sulfates, natural, n.e.s.: Aluminum sulfate (alunite)	[e]10,000	10,000	20,000
Sulfur:			
Native, other than Frasch	19,452	21,000	20,040
Content of pyrite	[r]10,886	38,337	[e]17,350
Byproduct	61,000	69,000	NA
Total	[r]91,338	128,337	NA
MINERAL FUELS AND RELATED MATERIALS			
Asphalt, natural thousand tons	457	463	434
Carbon black	--	14,100	15,800
Coal:			
Bituminous thousand tons	[r]4,584	4,506	[e]4,500
Lignite do.	[r]6,866	8,204	[e]8,200
Coke and semicoke:			
Metallurgical do.	[r]1,401	1,821	1,750
Gashouse[e] do.	[r]144	150	150
Breeze do.	[r]104	139	[e]135
Total do.	[r]1,649	2,110	2,035
Gas:			
Natural:			
Gross[e] million cubic feet	4,600	5,200	NA
Marketed do.	2,300	2,600	NA
Manufactured (from coal gas plants) do.	4,427	4,792	[e]4,800
Petroleum:			
Crude thousand 42-gallon barrels	22,167	18,392	19,428
Refinery products:			
Gasoline do.	16,899	16,660	19,848
Jet fuel do.	2,080	1,424	1,544
Kerosine do.	3,204	4,030	4,621
Distillate fuel oil do.	23,503	24,573	25,232
Residual fuel oil do.	37,865	35,771	42,671
Lubricants do.	511	903	1,142
Other:			
Liquefied petroleum gas do.	4,298	4,025	4,487
Naphtha do.	2,949	3,230	
Petroleum asphalt do.	1,765	1,736	5,580
Unspecified do.	101	714	
Refinery fuel and losses do.	[r]3,131	4,088	4,345
Total do.	[r]96,306	97,154	109,470

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]Includes lead content of lead ore and lead-zinc ore but excludes lead content of zinc ore.

[2]Includes zinc content of zinc ore and lead-zinc ore but excludes zinc content of lead ore.

TRADE

In 1977, mineral exports increased to $200 million or 7% of total exports. Principal mineral exports were boron materials ($80 million), chromite ($60 million), and magnesite ($12 million). Other significant mineral exports included meerschaum, diasporite, emery, zinc concentrate, and alumina. Imports of minerals increased 32% in 1977, accounting for $111 million or 2% of total imports. Phosphate rock, iron ore, and coking coal were the leading nonfuel mineral imports.

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Table 2.—Turkey: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Ore and concentrate	75,000	11,160	All to Romania.
Oxide and hydroxide	36,657	NA	
Metal, semimanufactures	r3,092	8,556	Saudi Arabia 2,742; Kuwait 2,109; Syria 1,384; Iran 924; Iraq 844.
Antimony:			
Ore and concentrate	r1,776	NA	
Metal including alloys, all forms	r205	NA	
Arsenic, natural sulfides	5	NA	
Chromium ore and concentrate	648,484	608,435	Switzerland 109,707; United States 107,107; Italy 90,917; Japan 63,129.
Copper metal including alloys:			
Unwrought	5,540	NA	
Semimanufactures	r100	NA	
Iron and steel metal:			
Ferroalloys	6,364	8,050	Netherlands 2,650; United Kingdom 1,750; Belgium-Luxembourg 1,175; Romania 800.
Semimanufactures	r14,499	24,067	Syria 12,746; Iran 3,096; Iraq 2,575.
Lead ore and concentrate	6,625	9,450	United Kingdom 4,000; Switzerland 3,600.
Mercury 76-pound flasks	96	NA	
Molybdenum ore and concentrate	18	NA	
Tungsten ore and concentrate	9	NA	
Zinc ore and concentrate	51,548	25,952	Italy 11,302; Belgium-Luxembourg 7,150; Bulgaria 5,500.
Other:			
Ores and concentrates	--	2,795	Yugoslavia 995; West Germany 900; Belgium-Luxembourg 600; Italy 300.
Metals including alloys, all forms	--	347	Bulgaria 275; Netherlands 35.
NONMETALS			
Abrasives, natural, n.e.s	58,719	49,932	France 32,869; United Kingdom 11,187; Netherlands 5,875.
Barite	35,406	NA	
Boron materials:			
Crude natural borates	391,215	NA	
Oxide and acid	7,247	NA	
Cement thousand tons	848	566	Syria 237; Libya 114; Iran 97.
Chalk	3,296	NA	
Clays and clay products:			
Crude:			
Bentonite	10,200	NA	
Kaolin	1,506	NA	
Other	30	NA	
Products:			
Refractory	325	17	NA
Nonrefractory	59	789	Saudi Arabia 571.
Diatomite and other infusorial earth	160	NA	
Gypsum	1,500	NA	
Lime	878	6,150	Saudi Arabia 3,913.
Magnesite:			
Crude	14,650	NA	
Calcined	63,648	NA	
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked, calcareous	12,025	14,287	Italy 5,126; Syria 4,328; West Germany 2,268.
Worked	6	NA	
Dolomite	30	NA	
Talc	179	NA	
Other:			
Crude, meerschaum, amber, jet	12	NA	
Unspecified	16,652	NA	
MINERAL FUELS AND RELATED MATERIALS			
Coal and coke and briquets thereof	200	NA	
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	2,026	660	West Germany 176; United Kingdom 168; Sweden 153; Belgium-Luxembourg 128.
Kerosine and jet fuel do	659	475	Netherlands 301; Lebanon 136.
Other do	1	NA	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	r126,858	151,475	Italy 54,637; France 39,138; Belgium-Luxembourg 19,773; Netherlands 19,647; Portugal 18,279.

rRevised. NA Not available.

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Table 3.—Turkey: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976[1]	Principal sources, 1976
METALS			
Aluminum:			
Oxide and hydroxide	1,184	NA	
Metal:			
Scrap	395	NA	
Unwrought	51,681	26,861	Canada 11,148; Switzerland 4,212; Norway 2,891.
Semimanufactures	2,659	3,202	Yugoslavia 1,151; Sweden 764.
Arsenic trioxide, pentoxide, acids	90	NA	
Cadmium metal including alloys, all forms	19	NA	
Chromium oxide and hydroxide	243	NA	
Cobalt:			
Oxide and hydroxide	17	NA	
Metal including alloys, all forms	1	NA	
Copper:			
Ore and concentrate	2	NA	
Metal:			
Scrap	498	240	Yugoslavia 146.
Unwrought	1,275	5,155	United Kingdom 2,983; Bulgaria 1,997.
Semimanufactures	5,725	6,960	Italy 1,963; Belgium-Luxembourg 1,958; West Germany 1,815.
Iron and steel:			
Ore and concentrate thousand tons	234	413	India 159; Brazil 130; United States-Puerto Rico 105.
Metal:			
Scrap do	85	236	United States-Puerto Rico 115; Switzerland 71; West Germany 25.
Pig iron, ferroalloys, similar materials do	134	116	Switzerland 29; West Germany 19; United Kingdom 19; Japan 11.
Primary forms do	r739	761	West Germany 166; Switzerland 162; Japan 157; Bulgaria 74.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	504	212	West Germany 96; Switzerland 30.
Universals, plates, sheets do	280	55	Japan 29; West Germany 10; Bulgaria 8.
Hoop and strip do	5	6	Japan 3; West Germany 1; Austria 1; France 1.
Rails and accessories do	18	7	United Kingdom 5; Yugoslavia 1; West Germany 1.
Wire do	9	3	West Germany 2; Japan 1.
Tubes, pipes, fittings do	117	113	France 33; West Germany 25; Italy 25; Japan 11.
Castings and forgings do	1	2	France 1; Italy 1.
Total do	934	398	
Lead metal including alloys:			
Scrap	2,069	1,286	All from United States-Puerto Rico.
Unwrought	4,724	7,468	Yugoslavia 3,798; United Kingdom 2,640; Bulgaria 847.
Semimanufactures	270	1,422	Mainly from Japan.
Magnesium:			
Unwrought	161	e175	Norway 124.
Semimanufactures	3	--	
Manganese:			
Ore and concentrate	4,852	3,130	All from Belgium-Luxembourg.
Oxide	823	NA	
Metal	61	NA	
Nickel:			
Matte, speiss, similar materials	332	384	United Kingdom 236; Netherlands 111.
Unwrought and semimanufactures	e181	155	West Germany 85; United Kingdom 28; France 14.
Platinum-group and silver metals including alloys:			
Platinum-group troy ounces	611	NA	
Silver do	140,756	NA	
Tin:			
Oxide	22	NA	
Metal including alloys, all forms	r1,182	901	United Kingdom 313; Netherlands 207; Belgium-Luxembourg 181.
Titanium:			
Ore and concentrate	2,132	NA	
Oxide	2,035	NA	
Zinc:			
Oxide	2,505	NA	
Metal including alloys:			
Scrap and blue powder	130	488	Canada 250; Belgium-Luxembourg 239.
Unwrought	17,384	23,450	West Germany 7,516; Belgium-Luxembourg 5,455; Switzerland 2,375.
Semimanufactures	r961	1,433	Yugoslavia 682; Belgium-Luxembourg 403; France 186.
Zirconium ore and concentrate	37	NA	
Other:			
Ash and residue containing nonferrous metals	440	NA	
Oxides, hydroxides, peroxides of metals	r161	NA	
Metals:			
Alkali, alkaline earth, rare-earth metals	1	NA	

See footnotes at end of table.

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Table 3.—Turkey: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976[1]	Principal sources, 1976
METALS —Continued			
Other —Continued			
Metals —Continued			
Base metals including alloys, all forms, n.e.s	8	247	Norway 124.
NONMETALS			
Abrasives, natural, n.e.s.:			
Crude	(3)	NA	
Dust and powder of precious and semiprecious stones kilograms	1,907	NA	
Grinding and polishing wheels and stones	585	532	West Germany 225; Italy 83; United Kingdom 59.
Asbestos, crude	16,357	19,681	U.S.S.R. 7,383; Canada 3,737; West Germany 2,916.
Cement	1,811	528	NA
Chalk	92	NA	
Clays and clay products:			
Crude:			
Bentonite	27	NA	
Kaolin	5,334	NA	
Other	324	5,999	United States-Puerto Rico 4,545; United Kingdom 620.
Products:			
Refractory (including nonclay brick)	r33,016	47,211	U.S.S.R. 18,435; West Germany 6,268; United States-Puerto Rico 5,827; Austria 5,776.
Nonrefractory	r66	285	NA
Diamond, gem and industrial value thousands	$772	$40	Netherlands $20; United Kingdom $14.
Diatomite and other infusorial earth	232	NA	
Feldspar	85	NA	
Fertilizer materials:			
Crude:			
Nitrogenous	--	19,619	Romania 11,263; Austria 5,776; Switzerland 2,171.
Phosphatic	905,267	793,112	Morocco 283,279; Tunisia 255,572; Jordan 161,179; Israel 82,778.
Manufactured:			
Nitrogenous	173,610	922,425	Romania 268,279; Italy 148,701; Austria 104,874.
Phosphatic	1,384	NA	
Potassic	5	18,740	United States-Puerto Rico 7,710; France 7,677; Liberia 3,200.
Other	86,027	173,407	United States-Puerto Rico 100,206; France 39,084; Switzerland 34,116.
Fluorspar	160	NA	
Graphite, natural	573	NA	
Gypsum	2	NA	
Lime	83	NA	
Mica:			
Crude	104	NA	
Worked	29	55	Spain 50.
Pigments:			
Mineral	5	NA	
Iron oxides, processed	210	NA	
Precious and semiprecious stones, except diamond kilograms	4,675	NA	
Pyrite, gross weight	100,453	19,605	Cyprus 18,407.
Salt	25	41,613	Mainly from Jordan.
Sodium and potassium compounds:			
Caustic soda	24,276	NA	
Caustic potash	829	NA	
Stone, sand and gravel:			
Gravel and crushed rock	339	NA	
Quartz and quartzite	421	NA	
Sand, excluding metal bearing	2	NA	
Sulfur:			
Elemental:			
Other than colloidal	2,004	6,475	Switzerland 3,150; Lebanon 1,888; Belgium-Luxembourg 837.
Colloidal	634	NA	
Sulfuric acid	354,792	NA	
Talc	410	NA	
Vermiculite	20	NA	
Other:			
Crude	636	1,819	West Germany 1,124.
Strontium and barium	194	NA	
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	50	NA	
Carbon black	5,234	NA	
Coal, including briquets	26,161	248,942	Mainly from United States-Puerto Rico.
Coke	--	17,790	Netherlands 7,877; Italy 6,968; Belgium-Luxembourg 4,945.

See footnotes at end of table.

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Table 3.—Turkey: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976[1]	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS — Continued			
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	r66,283	172,087	Iraq 53,997; Libya 20,774.
Refinery products:			
Gasoline do	72	286	Romania 229; Italy 57.
Kerosine do	2	NA	
Distillate fuel oil do	510	681	Romania 343; Yugoslavia 337.
Residual fuel oil do	3,122	4,353	Venezuela 939; Romania 747; Bulgaria 731; U.S.S.R. 522; Italy 436.
Lubricants do	706	259	West Germany 59; United Kingdom 58; United States 56; Netherlands 34; Romania 31.
Other:			
Liquefied petroleum gas do	1,512	(4)	
Mineral jelly and wax do	r49	54	West Germany 22; Hungary 8; Israel 7; Romania 6.
Unspecified do	3	89	United States-Puerto Rico 65; West Germany 24.
Total do	5,976	5,722	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	28,718	1,808	Netherlands 1,481.

rRevised. NA Not available.
[1]Commodity Trade Statistics, 1976.
[2]Includes some beryllium.
[3]Less than 1/2 unit.
[4]Total quantity not reported; valued at $31,900.

COMMODITY REVIEW

METALS

Aluminum.—Located principally in the Taurus Mountains, bauxite deposits were estimated to contain reserves of 400 million tons of 46% Al_2O_3. MTA calculated that Turkey possessed 4% of the world's known bauxite reserves.

Etibank's aluminum smelter at Seydisehir operated at about 25% of capacity most of the year because of a shortage of electric power. The capacity of the Seydisehir Integrated Aluminum plant (SIA) was rated at 200,000 tons of alumina, 60,000 tons of aluminum, and 34,000 tons of semifinished products per year. The primary bauxite minerals processed by SIA were boehmite and gibbsite.

Antimony.—Production of antimony ore in 1977 was 38,318 tons, an increase of 12% over that of the previous year. The major producing mine, Turhal, was situated near Tokat in central Anatolia. Substantial reserves were known in the Balikesir-Kutahya and Aydin regions. Tectomin (Italy) was contracted to construct a 2,600-ton-per-year antimony plant in the Province of Balikesir. Production at the plant was expected to begin by the end of 1978. MTA estimated Turkey's reserves of antimony at 2.4 million tons, which was nearly 1.7% of the world's known reserves in 1977. Demand for antimony in the world market stimulated MTA exploration for economic deposits in the western and central areas of Turkey.

Chromite.—MTA calculated chromite reserves at 35 million tons in 1977. Chromite deposits in Turkey are associated with ultrabasic rocks, especially peridotite and serpentine. Chromite production by both State and private enterprises totaled 905,524 tons in 1977, a decrease of 4% from that of the previous year. Output of chromite concentrates increased 10% in 1977 from the 1976 level. Etibank's new ferrochrome plant at Elazig produced 25,000 tons of high-carbon ferrochrome in 1977, which represented 50% of the plant's capacity. The Elazig plant was to commence full production in 1978. Construction continued on a ferrochrome plant near Mardin with production of 50,000 tons per year scheduled for 1978.

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Etibank was conducting an exploration program at the Guleman ore district believed to be a potential source of high-grade metallurgical chromite.

Copper.—Production of copper ore in 1977 increased 14% to 2.3 million tons. MTA estimated reserves of copper at 4 million tons of metal equivalent. Deposits were located in Ergani, Cakmakkiay, Damar, Cayeli, Kure, Lahanos, and Madenkoy. Etibank and Black Sea Copper each operated a mine in the Black Sea Zone (Küre) and on the East Anatolian Massif (Murgul). Black Sea Copper was 72% State owned, of which Etibank controlled 29.4%. The remaining 28% ownership was private, with Işbank as one of the principal shareholders. Black Sea Copper planned to increase the output of copper ore at the Murgul mine to 4.1 million tons per year and to increase concentrator capacity to 180,000 tons per year of copper concentrates.

Etibank and Black Sea Copper jointly contracted a Finnish company to construct a concentrator and smelter in Küre in 1978 with an annual capacity of 2 million tons of ore. At Samsun, the Black Sea Copper smelter, with a design capacity of 40,000 tons per year of blister copper, had not reached planned output by yearend. Etibank planned an integrated copper project at Küre-Cayeli to produce 100,000 tons of blister copper annually along with about 50,000 tons of zinc, gold, silver, and cadmium.

Iron Ore.—Iron ore production in Turkey was 3.3 million tons in 1977, a decrease of 8% from the 1976 output. Iron ore reserves of Turkey have been estimated at 870 million tons. Two significant iron ore occurrences are located in Sivas and Malatya Provinces; the Divrigi and the Hassan Celebi deposits. The Divrigi mine supplied lump ore (57% iron) for the State-owned Divrigi Concentration and Pelletizing Plant. The capacity of the mine was 2.6 million tons per year, to be expanded to 5.2 million tons of iron ore per year beginning in 1979.

The Hassan Celebi deposits had reserves estimated at 306 million tons of ore with a grade of 28% to 48% magnetite, equivalent to 118 million tons of 58% iron ore. The ore consisted of low-grade magnetite in nine massive occurrences and occasionally in disseminated form. In Kayseri and Adana Provinces, a large sedimentary iron belt was present. The deposit was analyzed as low-grade ore that would require beneficiation. In the Bitlis Massif of southeastern Turkey, an extensive deposit of iron ore was associated with metamorphic rocks and generally occurred as magnetite. Examination of the Bitlis Massif iron ore indicated that beneficiation would be necessary.

Iron and Steel.—Production of raw steel registered a decrease of 4% to 1.4 million tons. A contributing factor in the decline was a lack of foreign currency which limited the import of capital goods necessary for the industry. Turkey operated three iron and steel plants, with a fourth in the planning stage. The Karabuk iron and steel complex utilized domestic ore from Divrigi, while the Eregli iron and steel plant used both domestic and foreign ore. The 2-million-ton-per-year Iskenderun steel plant produced only iron metal and not steel because of difficulties in importing both coal and iron ore. Expansion of the Iskenderun facility was to increase annual capacity to 4 million tons. Studies were underway for a fourth iron and steel complex with a capacity of 2 million tons per year at Sivas by Ayyildiz of Turkey and Kaiser Steel Corp. of the United States. The feasibility study was expected to be completed by yearend 1978.

Lead-Zinc.—Production of lead-zinc ore increased to 106,250 tons in 1977, an increase of 18% over the 1976 level. MTA estimated reserves of lead at 1.3 million tons and reserves of zinc at 3.6 million tons, both reported in metal equivalents. Three belts of base metal mineralization have been identified by MTA as the most important mining regions in Turkey for copper, lead, and zinc. One belt is associated with the basic volcanic units of the ophiolite rocks that occur in southeastern Turkey. Here, Madenkoy, in Siirt Province, was identified as having the most significant lead-zinc deposits. Another belt extends through southeastern Turkey's central Taurus region. Mineralization is of the strata-bound type containing lead and barite. In northern Turkey, another major belt of base metals extends from the eastern Black Sea area to the western end of the country. The northern belt divides into two sections, one extending through northern Thrace in Bulgaria and the other striking through Balikesir to the south of the Sea of Marmara.

The new Cinkur-Kursun Metal Sanayii A.S. lead-zinc plant at Kayseri in central Anatolia processed concentrates from the Zamanti mines to recover zinc, lead, and silver. Etibank's Keban Works produced

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lead and zinc concentrates. The ore was extracted by underground mining and concentrated by a flotation plant erected near the mine. The concentrate has 50% lead with substantial quantities of silver. Zinc concentrates produced at Keban Works were principally derived from sphalerite. The flotation plant near the mines produced 40% zinc concentrates. The concentrates were exported for custom smelting and returned as metal for domestic consumption.

Manganese.—MTA reported manganese ore reserves at 32 million tons with a metal content of 30.3%. Production of ore in 1977 amounted to approximately 33,715 tons. No production of ferromanganese was reported in 1977. Production of manganese came from mines between Bolu and Zonguldak and near Denizli, Gaziantep, and Eregli.

Mercury.—Mercury and antimony mineralization are closely associated in Turkey. Reserves of mercury were reported at 12,000 tons in metal equivalent. Production for 1977 from Etibank's Sizma and Halikoy smelters totaled 4,509 flasks, a decrease of 15% from that of 1976. The decrease in production was a result of the decline in world market prices and the subsequent closing of some private companies. Substantial reserves of mercury ore were located in western and central Anatolia. The principal mercury mines were the Halikoy and Turhonu mines near Aydin, the Karaburn mine near Izmir, and the Sizma and Sarayonu mines near Konya.

Tungsten.—The major deposit of tungsten is located in the Ulu Dag Mountains near Bursa. MTA estimated the Ulu Dag deposits to contain 14.5 million tons of ore at 0.3% WO_3. The Elazig-Keban district possessed another 500,000 tons at 0.5% WO_3 ore. Tungsten mineralization occurs in Turkey in skarns in association with contact zones of acid intrusives. The mine and concentrator at Ulu Dag, a joint venture of Etibank and Salzgitter AG of the Federal Republic of Germany, began production in 1976. Approximately 2,000 tons of scheelite concentrates was produced annually and exported to the Federal Republic of Germany for further processing.

Uranium.—Reserves of uranium were reported at 4,000 tons of U_3O_8. Significant uranium mineralization has been located by MTA in the Neogene sediments in various areas. Extensive surveys of the Manisa-Afyon region have been conducted. A pilot plant was established at Koprubas to produce yellow cake (U_3O_8). In mid-1977, a survey by Woods Hole Oceanographic Institute uncovered further uranium reserves in deep water off the Black Sea coast. No other details were known by yearend. MTA carried out surveys on the Neogene basins in Thrace and near Ankara.

NONMETALS

Asbestos.—Production of asbestos, mostly chrysotile, decreased to 3,767 tons in 1977 from nearly 10,000 tons in 1976. Reserves were estimated at 5 million tons of asbestos ore. Principal deposits were located in the vicinity of Sivas, Erzincan, and Bursa. No exports of asbestos were reported in 1977.

Barite.—According to a report by MTA, barite reserves were calculated at over 33 million tons of ore. Barit Maden Turk A.S. (BMT) was the sole producer of barite in Turkey in 1977. The important producing regions were Muş, Alanya, and Konya. Barite occurred throughout Turkey as vein deposits, generally associated with schists.

Boron.—Occurring in Neogene lacustrine sediments, Turkish boron deposits comprised 80% of known world reserves. MTA estimated boron reserves at nearly 506 million tons of ore. The principal deposits are located in the Kütahya-Eskişehir-Balikesir area of western Turkey. Combined production from State and private firms increased 21% to 1.1 million tons in 1977. The Kirka tincal mine has a capacity of 750,000 tons per year. A refinery was planned for Kirka-Eskişehir, the world's largest tincal deposit. Construction of the Etibank plant at Kirka was to cost $65 million, with completion scheduled for early 1978. The refining facilities were to produce 163,000 tons of crude pentahydrate borax, 60,000 tons of crude and anhydrous borax, and 15,000 tons of refined decahydrate borax per year. Upon operation of the facility, Turkey was expected to earn $35 million per year through export of the products.

The Bandirma Borax and Acid Works operated at full capacity throughout the year. Borax decahydrate produced at the Bandirma plant consisted of refined crystals of technical grade containing 37% B_2O_3 and 16.5% Na_2O. The product was exported from the port of Bandirma on the Marmara Sea. Boric acid was also produced at the Bandirma works as technical-grade refined crystals containing 56.2% B_2O_3. The European market was the major recipient of the boric acid.

Cement.—Production of cement in 1977 registered an increase of 12%. Turkish ce-

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ment production capacity was 14.5 million tons concentrated in 34 plants. By 1980, Turkey expected to increase cement production capacity to nearly 20 million tons per year. The cement plant at Adana, Turkey's largest, was being expanded 67% to a capacity of 1.5 million tons per year by 1978.

Emery.—Reserves of emery were estimated at 9 million tons. Production of emery in 1977 declined 4% to 64,488 tons. Turkey has provided nearly 80% of world emery production. Turkish emery's fine-grain quality has increased the demand for it for use in coated abrasives. Production of emery could be increased with increased demand. Turkish emery contains approximately 62% alumina and 32% magnetic iron oxide. Mugla was the center of the emery industry, and Gulluk was the port of export.

Magnesite.—Turkish magnesite reserves were estimated at over 65 million tons of high-grade ore. In 1977, Summerbank and Etibank undertook an extensive magnesite development program. Several magnesite deposits were located at Eskişehir, Bilecik, Bursa, Denizli, and Içel, and were mined by open pit methods. Production of magnesite increased 21% in 1977. Valued at $12 million, magnesite was one of Turkey's most important mineral export commodities. The plant at Kumas near Kütahya, an Etibank joint venture, produced 70,000 tons per year of sintered magnesite and planned to produce 55,000 tons per year of refractory brick within 5 years. Etibank announced plans to establish a 100,000-ton-per-year sintered magnesite brick plant at Eskişehir. The completion date and cost were not available at yearend.

Marble.—Reserves of marble were estimated at 1.3 million tons in 1977. The provinces of Denizli, Erzurum, Izmir, Kirşehir, and Sivas and Marmara Island were the principal locations of marble deposits. Production of marble in 1977 was 118,600 tons valued at $11.1 million. High-quality marble was exported as both unfinished blocks and finished products.

Perlite.—Production of perlite in 1977 was estimated at 30,000 tons, a 22% increase over that of the previous year. Deposits of perlite are located in central Turkey and in the southwestern regions of Van, Erzerum, and Nevşehir. MTA estimated reserves of perlite to be more than 4.7 billion tons in 1977. Construction of an integrated perlite mine and processing plant continued at Cumaovasi-Ismir. Upon completion, the plant was to produce 137,000 tons per year of processed perlite and 50,000 tons per year of expanded perlite. The second stage of the plant, to be completed in 1978, is to manufacture prefabricated building material. The total cost of the project was set at $15 million.

Phosphate.—Production of phosphate rock in 1977 was reported at 65,418 tons. MTA estimated phosphate reserves at 410 million tons of ore of 10% to 21% P_2O_5. Phosphate reserves were considered adequate to supply the country's needs. A feasibility study was undertaken for the exploitation of the phosphate rock deposit at Mazidag, in southeastern Turkey.

Pyrite.—Production of pyrite declined in 1977 to about 38,300 tons from a 1976 level of 84,630 tons. The Ergani, Murgul, and Küre Copper Works produced pyrite concentrates as a byproduct of copper production. Pyrite concentrates were used for the production of sulfuric acid in Turkish acid plants while cupriferrous pyrite was exported, primarily to the Federal Republic of Germany.

Sulfur.—Sulfur production remained relatively stable in 1977 at 20,040 tons from 89,600 tons of ore. MTA reported sulfur ore reserves of more than 1.6 million tons. Etibank was to expand the Keciborlu Sulfur Works to produce 180,000 tons per year of crude sulfur and 55,000 tons per year of pure sulfur. At Keciborlu, ore was extracted by underground and open pit methods. Production was for domestic consumption with nearly 75% going to the industrial sector and the remainder going to agriculture.

MINERAL FUELS

Coal.—Lignite production from five Turkish operations totaled 8.2 million tons in 1977. MTA estimated Turkish lignite reserves at nearly 5.7 billion tons. Neogene sedimentary basins containing lignite cover vast regions of Turkey. In western and central Turkey, large reserves of lignite are known to exist at Tuncbiek, Seyitomer, Soma, Beypazari, and Yatagan. In southeastern Turkey, another large deposit of lignite is located at Elbistan. The Elbistan deposit was estimated to contain over 3 billion tons of lignite. The expansion of the Elbistan project by TKI continued in 1977 and was near completion. In 1979, output was to reach 20 million tons of lignite, of which 87.5% was to be used to supply thermal powerplants and 12.5% for other domestic fuel requirements. Lignite in the deposit has been rated as of low calorific

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value that will require treatment before domestic use. MTA reported other Neogene basins of lignite potential including an area near Erzurum where extensive exploration continued throughout 1977.

Bituminous coal reserves were estimated at 1.3 billion tons. Production from the Zonguldak coalfield was 4.5 million tons in 1977. Both advance and retreat longwall methods were used in the underground mining of the bituminous coal. There were six operating collieries. Most hard coal in the Zonguldak district was used by State railroads, by steel and gas plants, and as a source of coking coal. TKI produced all Turkish bituminous coal and about 70% of the lignite.

Petroleum.—Petroleum production totaled 53,227 barrels per day in 1977 which supplied about 25% of the country's requirements. Turkey also imported crude oil during the year, primarily from Iraq.

Crude oil reserves were estimated at 65 million barrels. Türkiye Petrolleri Anonim Ortakligi (TPAO) (Turkish Petroleum Corp.), a Government company which produced about 25% of the country's oil, continued its extensive exploration program. In 1977, TPAO discovered oil in the southern Diyarbakir region near Tigris. The well tested 1,100 barrels per day from a depth of 8,000 feet. TPAO was also reported to have discovered oil in two wells near Adiyaman on the Syrian border.

The 1,000-kilometer petroleum pipeline linking Turkey and Iraq began operation in 1977. The pipeline extended from Iraq's northern Kirkuk oilfield area to the Turkish port of Dortyol on the Gulf of Iskenderun. By yearend, Turkey's offtake from the pipeline was nearly 200,000 barrels per day or 66% of the pipeline's capacity. The Iraqi Government agreed to increase Turkey's liftings as the capacity of the line is eventually boosted to a maximum of 700,000 barrels per day.

Turkey's four petroleum refineries had a total capacity of 14 million tons of petroleum products per year. TPAO operated refineries at Batman and Izmir. The Izmir refinery was to increase production capacity to 5 million tons per year by 1979. Istanbul Petrol Rafinerisi (IPRAS) was to increase the production capacity of its refinery at Izmit to 13 million tons per year with the construction of two new units.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Turkish lira (LT) to U.S. dollars at a rate of LT17.77=US$1.00.

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The Mineral Industry of the U.S.S.R.[1]

By V. V. Strishkov[2]

The U.S.S.R., with a centrally planned economy, is the world's second largest producer of industrial products. It is the leading world producer of iron ore, manganese ore, platinum-group metals, petroleum, steel, potassium salts, asbestos, and cement. It occupies second place, following the United States, in world output of aluminum, lead, natural gas, coal, and phosphate rock; it ranks second, after Canada, in the production of nickel; and is second to the Republic of South Africa in gold and chromium ore output. The U.S.S.R.'s mineral industry has been the major factor in the country's development and continues to be a principal support of the country's strong industrial growth. The country has large reserves and resources of many minerals and its mineral exports make the U.S.S.R. mineral industry a significant factor in the mineral economy of the world.

Compared with 1976 figures, the following increases, in million tons, were reported: raw coal and lignite, 10.0; oil (including condensate), 26; natural gas (billion cubic meters), 25; iron ore, 0.9; pig iron, 2.0; crude steel, 2.0; finished rolled ferrous metals, 0.6; steel pipe, 0.2; mineral fertilizers (Soviet standard), 4.5; and cement, 3.0. Electric power output increased 39 billion kilowatt-hours. Output of many nonferrous, rare, and precious metals, oil refinery and petroleum products, and nonmetallic minerals was also higher than in 1976.

Reportedly, industrial output increased 5.7% (5.6% planned), and its value increased by 30 billion rubles, from 532 billion rubles[3] in 1976 to 562 billion rubles in 1977. National income rose 3.6% (4.1% planned) to 398 billion rubles. Heavy industry (group A) output rose 6.0% (5.9% planned), and consumer goods (group B) production rose 5% (4.9% planned). Investment rose to 122 billion rubles at the planned rate of 3%.

Despite the impressive gains in mineral production, reported in the Soviet press, there have been consistent reports of failures to reach planned goals for several mineral commodities and to supply industrial needs. New goals set for 1976-80 were chiefly to fulfill quantitative targets in the mineral commodities; there were indications that a considerable part of industrial output did not meet Soviet standards of quality.

Goals of the 1977 plan were closely approached in many areas of the mineral industry, as can be seen from the following tabulation:

Commodity	1977 (million tons)	
	Planned	Reported
Iron ore (usable)	243.3	240
Pig iron	110.2	107
Steel, raw	151.1	147
Coal, raw (bituminous, anthracite, and lignite)	733	722
Crude oil (including condensate)	550	546
Natural gas billion cubic meters	342	346
Mineral fertilizers (Soviet standard)	98.5	96.7
Cement	NA	127
Power, electric billion kilowatt-hours	1,160	1,150

NA Not available.

The year 1977 was disappointing in terms of growth for the Soviet economy. Reported industrial growth exceeded the (reduced) plan target, but the key indicator, labor productivity, rose only by 4.1% (planned 5.3%). As in previous years, this shortfall must have been offset by an above-plan

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increase in the industrial-labor force. Soviet statistics for 1977 performance indicate that the growth rate has not been sufficient to bring the output of coal, iron ore, pig iron, steel, and mineral fertilizers to the levels foreseen for 1980.

The U.S.S.R. Ministry of Ferrous Metallurgy was unable to meet the 1977 plan for production of many types of products. Out of 64 enterprises, 55 were unable to meet the planned quota for rolled steel products in the first half of 1977.[4] Many industrial consumers did not receive many of the products ordered. Insufficient production of high-quality steel for special requirements such as aircraft and nuclear reactors compelled the machine-building industry to use other available products, and the shortage of rolled products forced the import of ordinary steel sections, steel pipe, and special steel from Japan and Western countries.

The Soviet Union's mineral economy continued its steady expansion in 1977 but at a slower rate. Expansion of the mineral industry continued to be achieved mainly through increased input of labor and capital rather than advancing technology. It is estimated that two to three times more investment and labor, in real terms, is required in the U.S.S.R. than in the principal countries of the West to achieve a given increase in mineral output.

With a total population of 260 million (139.1 million women and 120.9 million men) in January 1978 (a growth of 2.1 million in 1977), the Soviet economy employed 106.4 million industrial workers and 14.7 million farmers (Kolkhozniks). In 1977, women accounted for 51% of the labor force in the Soviet economy. Until recently, women represented a major labor reserve, but this reserve has been practically exhausted and the use of other Comecon[5] member nations' labor in the Soviet Union is growing.

Practically all sectors of the mineral industries maintained more production personnel than called for by plan targets. The Soviet ferrous and nonferrous industries employed over 3 million workers;[6] the ferrous industry alone accounted for about 1.4 million "production" workers, 75,000 university graduate engineers, and 125,000 graduate technicians. The Soviet coal industry employed 2,152,700 men and women, including 1.2 million "production" workers, some 0.7 million "nonproduction" workers, 212,800 graduate engineers and technicians, and 27,800 managers and general managers.[7] The coal industry employed 770,000 women, including 109,000 at underground mines.[8] The oil, gas, and petrochemical industries employed 2.6 million, including over 250,000 in the development of oilfields and gasfields.[9] The crude oil extraction industry employed about 740,000 and the gas extraction industry 240,000 persons.[10] The fuel and energy sector of industry employs more than 10% of all workers engaged in industry.[11] The standard workweek in the U.S.S.R. is 41 hours.

There were about 150,000 graduate mining engineers in the Soviet economy in 1975. Of these, 37% were employed in the coal industry, 11% in ferrous metallurgy, 10.5% in nonferrous industry, 3.3% in the construction material industry, 2.7% in the mineral fertilizers industry, and 35.5% in other branches of the national economy.[12] Mining engineers are trained at 38 Soviet institutes.

The piece-rate principle has become an important feature of industry. Soviet labor legislation requires that workers achieve a minimum output within a given period. This minimum is the work norm and is established for virtually every phase of employment. Following the significant increase in output quotas, there has been a substantial increase in the proportion of workers not meeting the increased quotas established during the last 3 years. For some mineral industry enterprises it amounted to 15% and more in 1975.[13]

Although the trade unions in Western countries are principally wage-bargaining organizations, their Soviet counterparts function largely as an avenue for increasing labor productivity and fulfilling planned quotas. The unions operate the insurance system and also work with management on safety. Practically every worker, including the entire management team, belongs to the union.

The administration of Soviet coal mines, with the approval of trade unions, has often used overtime work to fulfill the planned coal production quota; it has sometimes required workers to work two shifts in succession and has even required underground miners to work an 8-hour shift instead of a 6-hour shift, a violation of the labor law.[14]

The U.S.S.R. does not publish comprehensive data on injuries in the mineral industry. Available Soviet information reveals

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that in 1974 there were fatal injuries at 48% of the Soviet coal mines and at 3% of the metallic mines.[15] For many years, the largest number of accidents occurred at the coal mines of the Ukraine, Kazakhstan, and the Kuznetsk coal basin in Siberia.[16] The number of fatal accidents at development faces of the Ukrainian coal mines was 80% greater in 1974 than in 1969.[17] Accidents at many coal and metallic mines are caused mainly by inadequate ventilation, the low level of equipment repair, and violation of technological processes.[18] The accumulation of dust at work sites in underground mines of the Soviet Union is high and often exceeds the sanitary standard.[19]

The turnover of personnel in mineral industry operations ranged from 25% to 80% per year. This was caused mainly by the delays in building houses and providing public and medical services, by low material incentives, and by heavy manual work and unsafe working conditions.[20] At certain mineral industry operations there are insufficient workers. The shortage of qualified young workers, especially in the eastern regions of the country, was becoming acute. The Soviet press has already expressed serious apprehensions about the capability of the educational system to replace the present labor force at metallurgical enterprises.[21]

At the end of 1977, the Central Committee of the C.P.S.U. and the Council of Ministers of the U.S.S.R. issued a joint Decree "On Further Improvement of Training and Education of Students in High Schools and Their Preparation for Work."[22] The decree called for increasing the time devoted to labor education in the last two grades from 2 to 4 hours a week and arranging for the planned integration in the country's labor force of all high school graduates who do not continue their education. Much of what was proposed in the decree had already been several times attempted and rejected as inefficient.

Soviet statistical agencies do not publish data on the actual earnings of workers in the mineral industry, with the exception of highly paid underground "production workers." The average official monthly income of Soviet workers and employees in 1977 was 155 rubles, compared with 151 rubles in 1976, an increase of 2.6%. In 1977, the raising of the monthly minimum wage from 60 to 70 rubles continued in the North and Soviet Far East and in some European regions of the U.S.S.R. According to Soviet calculations, the minimum family income for satisfactory life is 100 to 150 rubles per person per month.[23]

Government Policies and Programs.—Soviet mineral policy is based on the principle of maximum self-sufficiency at any price. With State-owned and State-operated enterprises, low wage labor and low per capita consumption, the U.S.S.R. has become the most self-sufficient of the world's leading industrial nations. Actual or estimated costs of production in the U.S.S.R. are not a prime factor in the selling price of a commodity on the domestic or international market. The Soviet system permits the establishment of selling prices at any level believed desirable to meet political or economic requirements. Therefore, many mineral ventures in the Soviet Union would be uneconomic by Western standards. Mineral development, as the basis of industrial growth, holds a key place in Soviet economic policy. Very large sums are spent on mineral exploration and production; these funds are distributed over a dozen specialized ministries.

The Soviet mineral economy has been totally planned since 1929. Production goals are established at a very senior level and are formally approved by the Supreme Soviet of the U.S.S.R. There are 5-year plans and 1-year plans; both types of plans set a definite program for all mineral and energy resources. Besides setting national priorities and goals for each industry, the plans are law and carry mandatory obligations.

Relations With Comecon Countries.—Considerable attention is now being devoted to economic "integration" and industrial "cooperation" between the Comecon countries, and this makes East Europe, Mongolia, and Cuba more dependent upon the Soviet mineral industry. Between 1973 and 1975, the Comecon countries prepared and adopted a Synchronized Plan of Multilateral Integration Measures for 1976 and 1980. It covered the construction of joint industrial enterprises in the current 5-year plan, for the period to 1990, and in part to the year 2000.

The construction of the several industrial enterprises included in the Synchronized Plan is linked through Comecon countries on an "equalization" basis; that is, the countries that grant credits receive a corresponding quantity of products. An example is the construction of the Kiyembay as-

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bestos production complex in Orenburg Oblast', with an annual capacity of 500,000 tons of asbestos. The Comecon countries will supply the U.S.S.R. with raw materials, machines, equipment, and consumer goods. Soviet deliveries of asbestos to the countries participating in the project will amount to about 80,000 tons annually; beginning in 1980, they will run for 12 years. The reserves at the Kiyembay complex are adequate for 40 years.

Construction of the natural gas pipeline from Orenburg to the western border of the U.S.S.R. continued in 1977. It is expected that the European Comecon countries constructing this line will receive 15 billion cubic meters of gas in 1980. The 2,750-kilometer pipeline (1,420 millimeters in diameter) is to operate at 75 atmospheres pressure. Each country builds a segment of the pipeline on its own, with the appropriate number of compressor stations and other items required in the project.

In 1974, the U.S.S.R. and five European Comecon countries signed an agreement for additional iron ore capacities in the area of the Kursk Magnetic Anomaly and in the Ukrainian S.S.R. Under this project agreement the European member-countries were to provide credits to the U.S.S.R. amounting to 675 million rubles during 1974-78. At the same time, these countries concluded an agreement for additional capacities of selected ferroalloys in the U.S.S.R. in the ferroalloy works of Nikopol' (Ukraine) and Yermak (Kazakhstan). The East European countries supply different materials, machines, equipment, and consumer goods for the construction of the facilities. The U.S.S.R. is to deliver iron-containing raw materials and some ferroalloys to participating countries from 1979 through 1990.

In 1976, the U.S.S.R., Cuba, and six European Comecon countries concluded an agreement on the joint construction of nickel and cobalt facilities in Cuba. The Comecon countries were supplying both materials and specialists. A plant with a capacity of 60,000 tons per year nickel and cobalt was to be built, bringing Cuban production to 130,000 tons per year. The largest part was to be shipped to the U.S.S.R. and East European Comecon countries.

A considerable increase in nonferrous metal production was planned in the U.S.S.R. and Mongolia. A project for the construction of a copper smelter in Mongolia (based on the Chagan Suburga mine) and another project (based on the Ugodzir tungsten-molybdenum deposit) were under study. East Germany was assisting in the renovation and expansion of facilities at the Booken Chogt tungsten concentrator in Mongolia.

In June 1976, Bulgaria signed an agreement with the U.S.S.R. for joint development of its nonferrous industry in 1976-80 and beyond. The U.S.S.R. was to aid Bulgaria in the construction and modernization of 14 projects of the nonferrous industry. Construction of facilities for production of bauxite in Hungary, copper and zinc in Poland, and tin and tungsten in Czechoslovakia continued in 1977.

The Comecon countries were assisting in the construction of the potassium mineral fertilizers facility in the U.S.S.R. Some member-countries will participate in the construction of the second stage of the Kingisepp phosphorite complex in Leningrad Oblast' and in the development of the phosphorite basin "Hybsugul" in Mongolia.

The estimated costs of all projects under construction was over 9 billion rubles, only half of this amount being paid by the U.S.S.R. The further integration of economies of member-countries is an objective of the U.S.S.R. in the Comecon.

A plan for the development of a unified inter-Comecon power transmission system called for the creation of a single large power grid by 1990, to tie all the European Comecon countries and Yugoslavia into a single system. The 750-kilovolt line from Vinnitsa (U.S.S.R.) to Albertirsa (Hungary), to supply power to East European countries, was to be built jointly by the U.S.S.R. and Hungary.

The protocol on Yugoslav-Soviet economic and scientific cooperation, signed in October 1977, provides for an additional $210 million Soviet credit to Yugoslavia.

Relations With Developed Countries.—In its economic relations with developed countries, the Soviet Union strives for all-round economic "cooperation." Long-term agreements on developing economic, scientific, technical and industrial cooperation have been signed with the United States, the Federal Republic of Germany, France, Italy, the United Kingdom, Denmark, Austria, the Netherlands, Portugal, and Switzerland, and with many individual companies in the West. These provide for cooperation in the construction of industrial complexes, expansion and modernization of existing

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industrial enterprises, and research planning.

Soviet law does not permit private ownership of the "means of production," but foreign investors are invited to develop deposits and to construct plants in the U.S.S.R. and repayment is to be made in the form of production from these operations. Thus the Soviet Union is able to bring much needed investment and technology from Western countries by using "joint" or "compensation" venture arrangements. Joint operations are provided in such fields as the chemical industry, the ferrous and nonferrous industries, and the oil, coal, and mineral fertilizer industries. Agreements have been concluded with Western countries for construction of more than 60 large projects in the U.S.S.R. on a compensation basis. The U.S.S.R. needs Western technology to solve many of the problems in the mineral industry. At the same time, Soviet organizations are taking part in the construction of a number of industrial projects in developing countries.

Transition to large-scale cooperation on a long-term basis is a new feature in the U.S.S.R.'s trade and economic relations with many countries; early examples were with France, the Federal Republic of Germany, Italy, Finland, and the United States. Payback agreements have been signed with British firms. These agreements usually provide long-term bank credits to Soviet foreign trade organizations. The Soviet Union uses these credits to buy licenses, equipment, machinery, and materials for the construction of major industry projects. In their turn, the creditor countries, also on a long-term basis (usually 10 to 15 years), purchase in the Soviet Union a part of the finished products produced by these projects and other enterprises. The projects themselves become the property of the Soviet Union. The share of output exported as repayment of the credit usually amounts to 20% to 30%.

Relations With Developing Countries.—The Soviet Union encourages State-managed mineral resource development in the developing countries. The U.S.S.R. sends technicians and makes loans to countries willing to promote State development and distribution of fuels and minerals. Soviet technical assistance and economic aid programs include 426 industrial projects in about 70 countries at a cost of some 5 billion rubles. Soviet specialists provide technical assistance for geological research, prospecting, and exploration in 30 developing countries.

In many instances, developing countries pay for Soviet assistance with mineral commodities. The U.S.S.R. is now able to secure a substantial flow of mineral imports at low cost from friendly developing countries, and there are indications that it intends to extend this pattern to gain exclusive access, for itself and other Comecon countries, to deposits of exceptional quality.

The U.S.S.R. sent more than 6,000 Soviet geological and exploration personnel to more than 30 developing countries and supplied over 650 million rubles worth of prospecting equipment. The Soviet Union is to provide financing for a $300 million aluminum smelter to be built on the Indonesian island of Bintan. Reportedly, a major agreement has been signed for Soviet development of the Meskala phosphate deposit in Morocco, in exchange for Moroccan phosphate rock and triple superphosphate. The phosphate open pit is to begin production in the mid-1980's at a rate of 2 million tons per year, rising to 10 million tons per year by 1990. The Soviets are expected to be taking up to 9 million tons per year by 1990.

According to a Soviet source,[24] the following annual productive capacities had been constructed, were being constructed, or were to be constructed in the developing countries with Soviet assistance, as of January 1, 1977:

	Million tons
Pig iron	15.8
Steel-crude	19.6
Rolled steel products	15.2
Iron ore	14.0
Coal, raw	20.8
Crude oil	53.4
Petroleum products	19.1
Powerplants million kilowatt-hours	11.6

Reportedly, under an agreement signed in September 1977, the Soviet(50%)-Italian (50%) Tecnicon Co. was the first joint venture between a Western concern and a U.S.S.R. State agency. Tecnicon will specialize in the design and construction of steel plants in developing countries.

Projects built or being built in developing countries with Soviet assistance are as follows:

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	Under agreement	Already commissioned
By industry:		
Power engineering	80	46
Ferrous and nonferrous industries	39	18
Coal, gas and oil extraction	36	19
Chemical, oil refining and petrochemical industry	25	14
Mechanical engineering and metal working	53	41
Construction materials industry	35	13
Consumer and food industries	148	69
Agricultural	147	71
Transport and communications	94	59
Prospecting and exploration	65	32
Education, culture and health	238	145
By region:		
Asian countries:		
Afghanistan	38	17
India	45	31
Iraq	51	17
Iran	76	43
Yemen	5	3
Pakistan	5	1
Syria	15	9
Turkey	11	6
Sri Lanka	7	5
African countries:		
Algeria	31	22
Egypt	47	31
Guinea	9	6
People's Republic of Congo	3	2
Mali	1	1
Somalia	12	5
Sudan	6	6

Source: Foreign Trade, Moscow, No. 6, June 1977, pp. 13-14.

During 1977, Soviet theoreticians and practitioners searched intensively for ways of improving the economic system. Statements made by Soviet economists show that the indicator of "realized" production—that is, output accepted and purchased by the consumer—which was introduced during the reform of September 1965, replacing the indicator of gross output (the "val") as a basic indicator of an enterprise's operation, did not meet expectations. The Soviet command economy continued to emphasize quantitative output and "fulfilling the planned targets."

In July 1977, the U.S.S.R. Council of Ministers adopted a decision on providing measures to economize in the use of fuel and energy resources; differentiated norms for the expenditure of fuel and energy per quarter were to be established for enterprises and organizations starting in 1977.

Transfer of Technology.—A leading article in Pravda (December 6, 1977) criticizes the lagging rate of introduction of new technology by Soviet industrial ministries, including ferrous metallurgy, petroleum and petroleum refining, and petrochemical ministries.

Western technology is a key factor that can favorably influence Soviet economic performance. The import of such technology does not resolve many of the contradictions in the Soviet economy, but it does accelerate the industrialization of the country.

the Federal Republic of Germany was the largest Western exporter of equipment and machinery to the U.S.S.R. in 1977. Its involvement included the construction of a gas transportation system in Siberia, deliveries of trucks for the construction of the Baykal-Amur Main Railway, and the construction of the Kama automobile works, Oskol metallurgical complex, and a number of large chemical complexes. The Japanese-Soviet Economic Committee, which was organized in 1965 at the suggestion of the U.S.S.R., plays a major role in developing Siberian natural resources using Japanese capital and know-how. In 1977 the committee was engaged in Southern Yakutia coking coal development, Yakutia natural gas exploration, and Sakhalin continental shelf oil and gas exploration. Reportedly, the Soviet Union offered to supply Japan with enriched uranium in exchange for nuclear-power-generating equipment. The Soviet and Italian Governments agreed on a new 3-year credit of $650 million (in addition to a previous $900 million), to be used for financing turnkey projects.

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Soviet imports of Western plants and technology related to mineral industry projects fall into several categories: Extraction, transportation, loading and refining of crude oil, and construction of petrochemical and metallurgical complexes.

The Soviet Union is planning to increase oil and gas production to boost foreign exchange earnings, as well as to improve its energy output. For development of these resources, it is turning to Japan, to West Europe, and particularly to the United States and planned to spend several billion dollars during 1976-80 on imports for the petroleum and gas industry alone. Petrobaltic, the joint Baltic offshore exploration company of the U.S.S.R., Poland, and German Democratic Republic, is looking in the West for a rig capable of operating in 700 meters water with drilling capacity up to 5,000 meters. The U.S.S.R. was also interested in the purchase of gas-lift extraction equipment, to be used in the development of Samotlor and Fedorovsk, two of the largest Soviet oilfields in Western Siberia.

Frendi Serete finished construction of a geological survey and coring vessel ordered by the Soviet Union. Negotiations between the U.S.S.R. and British Petroleum concerning foreign assistance in construction of a $150 million oil platform fabrication plant near Baku continued in 1977. The Soviet representatives also discussed this project with other Western firms. The Soviet Mashinoimport awarded a consortium of four Japanese firms a $10 million order for cast-steel valves, to be used in construction of an oil pipeline. The contract called for delivery within 1977. Reportedly, the Italian Pressindustria SpA won a 20,000-million-lire contract from the Soviet Union for a plant to produce 250,000 tons per year of nonionic surfactants, which are used in tertiary oil recovery. The plant was to go onstream in 1980.

A West German banking consortium granted a DM600 million credit to finance the latest Soviet order for 380,000 tons of large-diameter steel pipe from Mannesmann Handel A.G. and Thyssen Stahlunion A.G. The Soviet Union signed a $630 million contract with the Federal Republic of Germany for purchase of 17 compressor installations for use on the Orenburg natural gas pipeline. A new contract worth F130 million was signed between Constructions Metaliques de Provence and Mashinoimport. The French company was to supply equipment for the treatment and processing of gas at a plant in the western Ukraine. Its yearly output of 35 billion cubic meters was to be piped to Western Europe.

Mitsubishi Heavy Industries Ltd. received an order to supply 61 liquefied petroleum gas (LPG) compressors, to be shipped in 1978 and installed at three plants, to be built in the Tyumen' region, Western Siberia, by Japan Steel Works, Ltd., by 1980. Reportedly, Japan's Asahi Chemical Co. signed a contract with Tekhmashimport for delivery of technology for three benzene plants, each with an annual capacity of 120,000 tons, by 1981. Italy's contract to purchase Soviet natural gas was extended from its original 1992 expiration date to the year 2000 in repayment for more oil refinery and petrochemical construction work.

In 1976, Unit Rig signed two agreements for delivery to the U.S.S.R. of eighty-four 180-ton dump trucks worth $119 million. These were to be used in the Nerungra coal open pit in Yakutia.

According to the Finnish-Soviet protocol on the construction of the Kostamush iron ore project, signed in October 1973, a railroad and highway on the Soviet territory have already been built by the Finns from the national border to the Kostamush construction site. Annual mine output at Kostamush will be about 24 million tons of iron ore, from which about 8.9 million tons of iron pellets will be produced annually. The building of the concentration plant is to be carried out in three stages. The first stage is scheduled for completion in 1977-82. After completion of this stage, Finland will buy up to 1.2 million tons of pellets annually in 1983-90.

In 1976, the Pechiney Ugine Kuhlmann (PUK) signed a F1,200 million contract for the French to furnish equipment and assistance in construction of a million-ton alumina plant at Nikolayev on the Black Sea. This was to supply the Sayan aluminum plant near Abakan in Siberia. Specialists from PUK were also helping in the construction of the Sayan. The first potline was to be operational in 1980. PUK was assisting in the construction of the Regar aluminum plant in Tadzhikistan and was also seeking Soviet contracts for a 100,000-ton graphite electrode plant and for a selenium metal facility worth F500 million.

Midrex Corp. concluded a contract between Soviet Metallurgimport and Korf A.G. and Lurgi Chemie and Huettentechnik, the Federal Republic of Germany,

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for the construction of four Midrex 400 Series Direct Reduction Modules. The four Midrex Modules, with a total annual capacity of 1.7 million tons per year of high-quality iron, were to be constructed within the Oskol iron and steel complex in Belgorod Oblast'. The U.S.S.R. was negotiating with the Western firms on construction of the 100,000-ton-per-year Armansk No. 2 titanium dioxide plant. The contract value was about £100 million. The first Armansk plant, with a capacity of 30,000 tons per year, was built by Tecnimont using technology supplied by its parent, Montedison.

The Soviet Union signed a F340 million contract with Azote et Produits Chimiques and PEC Engineering of France to provide equipment for seven 1,200-ton-per-day liquid ammonia plants. An ammonia plant, with a capacity of 365,000 tons per year, was constructed by Toyo Engineering Corp. at the Nevinnomysk chemical complex. Soviet ammonia, to be delivered to France over a 10-year period starting in 1980, represents compensation for four ammonia plants supplied by Creusot-Loire. Czechoslovakia and Mitsui of Japan were to supply the U.S.S.R. with 10 ammonia plants. Negotiations were underway between the Soviet and Western firms for another ammonia plant, with an annual capacity of 450,000 tons, to be built at Angarsk by 1981.

Reportedly, five complex fertilizer plants, each with a capacity of 1,840 tons per day, were to be built by Toyo Engineering by 1981. Two of the plants were to be located at Novgorod, two at Rossosh (Voronezh Oblast'), and one at Dorogobyzh. Speichim of France has signed a F450 million contract for three 800,000-ton-per-year fertilizer plants scheduled for completion by 1981. The plants were to be located at Novyy Rozdol (Ukraine), at Byelorechensk near Krasnodar, and at Meleuz. France's Rhone-Poulenc has signed a $1,200 million contract with the Soviet Tekhmashimport for two-way trade in equipment for fertilizer plants and chemical products.

Spie Batignolles of France signed an agreement for the construction of nine phosphoric acid units, to be completed by 1980. Coppée-Rust of Belgium signed a $135 million contract with Tekhmashimport to build four phosphoric acid units by 1981; two at Cherepovets, one at Meleuz, and one at Byelorechensk. Société Krebs was to construct a 500-ton-per-day phosphoric acid plant in the Ukraine.

Reportedly, France's PEC-Engineering signed a F140 million contract with Tekhmashimport for the construction of a potassium chloride plant in 1980. A DM3 million contract was signed with GHH Sterkrade, for the supply of loaders, with bucket capacity of 5.6 cubic meters, and spare parts for use in potash mining. In 1975, the company supplied the U.S.S.R. with similar loaders.

The largest contract ever completed between the U.S.S.R. and the United Kingdom was signed in May 1977, when Davy Powergas Ltd. agreed to supply two complete methanol plants at a cost of $250 million. The units were to be built at Gubakha in the Urals and at Tomsk in Siberia. A consortium of companies to be led by Technip signed a $500 million contract with the Soviet Tekhmashimport to build two aromatic complexes, to be located at Ufa in the Urals and at Omsk in Siberia. The complexes were to be completed in 1980-81. According to an agreement, Czechoslovakia was to deliver to the U.S.S.R. three urea production units, each with an annual capacity of 161,000 tons. The units were to be installed at the Cherkassy, Dneprodzerzhinsk, and Grodno fertilizer plants. Poland signed a contract with the Soviet Union for the supply of three sulfuric acid plants. Forty-four sulfuric acid units, with a total capacity of 17 million tons per year, have been ordered from Poland, over half during the 1970-77 period.

Reportedly, British International Computers, Ltd., sold a computer worth £200,000 to the U.S.S.R. The Control Data Corp. sold a Cyber 172 computer system for use in oil and gas exploration offshore Sakhalin Island.

The Plan for 1978.—The State plan for 1978 was ratified by the Supreme Soviet on December 16, 1977. The original target for 1978, set as part of the 1976-80 plan, was reduced, and heavy industry production was to be stressed for the year. Industrial growth was to be 4.5% compared with the average annual rate of 6.5% projected in the tenth 5-year plan in 1977. Heavy industry was to grow by 4.7% (compared with 5.9% projected in 1977) and consumer goods industry by 3.7% (compared with 4.9% planned for 1977). Capital investment was to total 125.5 billion rubles, a 3.4% rise over that of 1977. Major investment areas in 1978 continued to be the fuel energy sector, the ferrous, nonferrous, chemical, and machine construction industries.

Special attention in the 1978 plan (as in 1977) was to be focused on the fuel and

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power sector. The generation of electric power was to be increased by 4.7% to 1,207 billion kilowatt-hours. The planned production of electric power was in line with the 1980 target of 1,340 to 1,380 billion kilowatt-hours. Because of the continuing fuel crisis and to improve the fuel-energy balance in the European part of the U.S.S.R., special attention was to be given in 1978 to the rapid expansion of nuclear powerplants. It was planned to complete a 1-million-kilowatt unit at the Novovoronezh, Chernobyl, and Kursk nuclear powerplants in 1978.

Crude oil extraction (including condensate) was planned at 575 million tons in 1978, 29 million tons over that of 1977. This goal was in line with the tenth 5-year plan (491 million tons in 1975 and 620 to 640 million tons planned for 1980) and suggested that the peaking of Soviet oil output predicted by some Western experts may occur later than originally expected. The increase in petroleum production in 1978 was to come from Western Siberia. Natural gas output was to amount to 370 billion cubic meters, an increase of 6.5% over that of 1977 and was to come mainly from Western Siberia, Central Asia, and Orenburg Oblast'. The planned output of natural gas was also in line with the 1980 target of 400 to 435 billion cubic meters.

Raw coal and lignite output was to be 746 million tons, 24 million tons over the 1977 level. The main increase was to be from open pit lignite operations in Kazakhstan and Siberia. Increased hard coal production was to be from the Donets, Kuznetsk, and Karaganda basins. The new 1978 target for raw coal and lignite implied that the 1980 goal (790 to 810 million tons) was unlikely to be met.

Raw steel output was to be increased by 5.6 million tons to 152.6 million tons. Compared with the 1977 production, finished ferrous rolled metal output was to be increased by 4.3 million tons to 106.3 million tons. The 1980 target for raw steel (160 to 170 million tons) was unlikely to be met. Steel pipe production was to be increased by 0.7 million tons to 17.7 million tons. It was planned to produce 101.5 million tons (Soviet standard) of mineral fertilizers in 1978, or 4.8 million tons over the 1977 level.

The 1978 nonferrous metallurgy plan called for increased production of aluminum, copper, and nickel. The output of platinum-group metals, gold, and rare and other nonferrous metals was also to be increased. It was planned to increase production of aluminum at the Krasnoyarsk and Regar plants and that of alumina at the Uralsk, Bogoslovsk, and Pavlodar plants. Geological exploration would be concentrated in the regions of established deposits and plants. The 1978 plan provided for a 10% rise in foreign trade. A number of industrial commodities were deleted from the 1978 plan report, including iron ore, pig iron, cement, and sulfuric acid.

Declining reserves of raw materials and fuels in the European part of the country have forced Soviet planners to give increased attention to the northern and eastern areas. Development and exploitation of these reserves will be difficult, however, and the extreme climatic conditions will necessitate large capital investments in railroad and pipelines for long-distance transportation.

The plan stressed that capital is to be channeled, in the first place, towards the technical reequipment of operating enterprises. The plan called for a low growth rate in key sections of the Soviet economy during 1978, including the smallest increase in heavy industrial production since World War II. The low economic goals made it likely that the Soviet Union will fall short of its many 5-year plan targets. The increases in 1977 and those projected for 1978 were below the 5-year planned average, while the index itself was distorted by the existence of covert inflation and the overvaluation of transfer payments.

The lower growth rates for the Soviet economy set for 1978 were indicative of key economic problems: low productivity of labor and equipment, low return on capital investments, hard-currency trade deficit, low recovery of metals from the ores, and misuse of mineral resources. The 1978 plan showed the beginning of a recognition by the Soviet planners that growth at any cost is bad economics. Soviet industrial production in 1977 and plans for 1978 are as follows, in million tons unless otherwise specified:

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Commodity	1977		1978
	Planned	Reported	Planned
Iron ore, usable	243	240	NA
Pig iron	110	107	NA
Steel, raw	151	147	153
Coal, raw (bituminous, anthracite, and lignite)	733	722	746
Crude oil (including condensate)	550	546	575
Natural gas billion cubic meters	342	346	370
Mineral fertilizers (Soviet standard)	98	97	101
Cement	NA	127	NA
Power, electric billion kilowatt-hours	1,160	1,150	1,207

NA Not available.

Exploration.—Over 5,000 deposits of various minerals were being exploited in 1977, and exploration continues on a large scale. There were over 500,000 employees in the geological and prospecting organizations of the U.S.S.R. in 1977, including over 65,000 graduate specialists with university educations and about 55,000 graduate technicians. Over 4 billion rubles was allocated for geological exploration in 1977. Over 2 billion rubles was for oil and gas, and some 200 million rubles was for coal. Over 2,500 geological and geophysical teams are permanently employed in oil and gas exploration, and about 2,200 exploratory wells are completed each year, using some 2,500 drilling rigs. In 1976, the Ministry of Geology did not meet the planned targets for petroleum prospecting.[25] There were 13 plants that supplied prospecting and exploration activities with machinery and equipment.

During 1971-77, exploration of the Talnakh and Oktyabr' copper-nickel and platinum-group metals in Krasnoyarsk Kray was completed, and the reserves were confirmed, enabling the Norilsk complex to expand its production of copper, nickel, cobalt, and platinum-group metals. Exploration of the Gay and Uzel'gin copper-pyrite deposits (in the Urals) and of the Vezhayu-Vorykvin (Timan) and Vislovsk (Kursk Magnetic Anomaly region) bauxite deposits was completed in 1977.

The coking-coal reserves at Neryungra in the South Yakutia Basin have been confirmed. An open pit, with a capacity of 13 million tons per year of raw coal, was under development. In the Kuznetsk Coal Basin, a group of deposits was explored for the development of a number of open pits, and in the Kansk-Achinsk Basin reserves of 3 billion tons lignite were confirmed in the northwestern part of the Aban deposit. The explored iron ore reserves of the Kursk Magnetic Anomaly were increased by 2.3 billion tons, and the Chernyanka deposit in Belgorod Oblast', with reserves of 1 billion tons, was prepared for development. An apatite deposit was discovered at Seligdar in South Yakutia, with reserves of 2 to 2.5 billion tons; this was the first such deposit in the Soviet Far East. Exploration of the vast territory of East Siberia and the Soviet Far East in the region of the Baykal-Amur Main Line (BAM) has been started. In 1977, about 200 teams were prospecting in the vicinity of BAM.

A Japanese firm was participating in geological surveys on the Sakhalin continental shelf under an agreement signed in 1975. The Sakhalin Petroleum Development Co. of Japan, established under the same agreement, has extended a credit to the U.S.S.R. permitting it to borrow a floating rig, special machines, ships, and other equipment needed for the geological surveys. In repayment, the Japanese company will receive Sakhalin oil. A joint Japanese-Soviet exploration has already resulted in an oil discovery on the northernmost tip of Sakhalin Island.

The 1976-80 5-year plan called for a substantial expansion of exploration, particularly in existing mining areas and in little-known regions of the Far North, East Siberia, and the Far East. The Ministry of Geology set the following main directions for prospecting in the Russian Federated Soviet Socialist Republic (R.S.F.S.R.) of the most important minerals in 1976-80:

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Oil and Gas.—Prospecting and exploration will be continued in the European North, and work in West Siberia is being intensified. Exploration continues in East Siberia to assess the prospects of this new gas-bearing region. The area near the Caspian Lowland is being studied, and work on a study of the offshore potential is being expanded.

Solid Fossil Fuels.—Prospecting and exploration is continuing in the European part of the R.S.F.S.R. to expand reserves of coking coal in the Pechora Basin, of anthracite in the Donets Basin, and of power-generation lignite in the Moscow Basin. In Siberia, exploration for coking coal in the Kuznetsk Basin and the South Yakutia Basin is at hand; in the Kansk-Achinsk lignite basin several open pits are being prepared for development.

Ferrous Metals.—Exploration is primarily to provide iron ore reserves for existing operations in the Northwest, the Central region, the Urals, and Siberia and for the preparation of new open pit operations in the KMA area.

In the Northeast region, exploration continues on ferrous quartzites and compound apatite-magnetite ores at the Olenogorsk and Kovdor mining complexes and at the Kostomush complex; in the South Urals work is being conducted on the magnetite deposits of the Tagil-Kushva iron ore region. To strengthen ore reserves for the West Siberian metallurgical complex, prospecting continues at Gornaya Shoriya, at Kuznetskiy Altau, and in the western Sayan Mountains. Simultaneously, prospecting is being expanded in the Angara and Aldan iron ore regions with a view to creating the raw materials base for new enterprises in the eastern regions. An appraisal program is being conducted at the promising manganese deposit at Porozhinskoye on the Yenisey Ridge and at a number of iron ore discoveries in the Trans-Baykal and Uda-Selemdzha regions. Prospecting for chromite ore is being conducted in the Arctic Urals.

Nonferrous Metals.—Prospecting for bauxite in the North Urals and Belgorod regions has been intensified. Promising areas of the Angara and the Altay-Sayan regions and other areas in Siberia are being examined. Prospecting is also being expanded in West and East Siberia for nepheline syenites and alunites.

To expand known copper reserves and to prepare new areas, prospecting for copper-pyrite ores has been intensified in the Urals. Exploration of Udokan deposit and adjacent regions is being expanded.

Lead and zinc exploration is aimed at strengthening the raw material base for existing operations in the North Caucasus, Altay, Baykal, and Primorsk regions. In Uzbekistan, exploration of the Sarycheku, Kalmakyr, and Dal'noye copper and Khandizin lead-zinc deposits continued in 1977. Prospecting for lead and zinc continues on the BAM route, where the Gorevskoye, Ozernoye, Kholodninskoye, and Sardana deposits have already been found.

The bulk of the prospecting and exploration for tin is being conducted within the tin-bearing zones of the Pacific Ocean folded belt and in the existing mining regions. Prospecting for the evaluation of tin-bearing areas—the Pyrkakayskoye, Telekayskoye, Pestrinskoye, and Odinokoye in the Northeast and at Khabarov Kray—will continue.

Mercury and antimony prospecting is planned mainly in the areas of existing enterprises in West Siberia, East Siberia, and the Yakutsk A.S.S.R. Simultaneously, exploration of the richest deposits of the Tamvatneyskoye, Zvezdochka, and Sentachanskoye areas in the Northeast is to be completed. The Yakhtons tungsten deposit has been developed for exploitation.

Nonmetallic Minerals.—Exploration of the deep levels of the Khibiny apatite deposit is to be conducted, and a study is to be made of the Seligdorsk Massif in the Aldan Mountains and of phosphorites at the Vyatka-Kama deposit. Prospecting for potash salts in the Volga-Urals region is to be continued, and prospecting has started at the Nepskiy dome of Irkutsk Oblast'.

The Ukraine contains 82% of the Soviet total explored reserves of manganese ores, 33% of iron ores, 29% of hard coal, and about 28% of coking coal.

The performance of geologists is measured not in the number of deposits explored, but in the footage of drilled holes and drifts—a fact that encourages the drilling of many shallow holes rather than the more time-consuming deep holes. As a result, in many cases, there are discrepancies in quantitative and qualitative indices between exploration reports and actual conditions of deposits. For example, actual indices of the Turgay bauxite and Sayansk copper deposits in Kazakhstan are different than those reported by geologists.[26]

Construction.—The U.S.S.R. continued to

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experience difficulties completing mineral industry projects on schedule because of shortages of material, equipment, and labor, and organizational problems. Construction of new projects remained slow, and expensive, and was frequently dispersed over a large number of projects. The work took two to three times as long as specified by the U.S.S.R. State Construction Committee. The 10- to 15-year period required to develop a mine with a capacity of 1 to 2 million tons per year contributed to disparities between the capacities of mines, mills, and metallurgical plants. The number of incompleted projects in the construction industry rose considerably in 1965-75; in 1965, only 1.7% of the total planned construction projects were not completed, but in 1975 the figure had risen to 40.8%.[27]

The plan calls for a certain amount of construction in a certain period, with goals expressed in terms of their ruble value. So the enterprises use more expensive equipment and materials than are needed. This is advantageous both to the construction workers and to industry, but the economy suffers large losses. The construction industry suffers particularly from deliveries. "It is no secret that idling in construction frequently amounts to 20% or more of the working time because of disruptions in the material supplies and other reasons," wrote Prof. D.V. Volovoy in a three-part series.[28]

Construction in industry is carried out mainly by the contracting method (80% of all the construction and installation work). The principal constructor in the nonferrous industry is the U.S.S.R. Ministry of Construction of Heavy Industry Enterprises (Mintyazhstroy). Its organizations also construct enterprises for ferrous and coal industries. The U.S.S.R. Ministry of Industrial Construction also does a large amount of constructing work (primarily enterprises for the chemical and petroleum refining industry). The average Soviet-planned cost of a 0.5-million-ton-per-year lead-zinc underground mine was 20.9 million rubles. The average planned cost of a Soviet lead-zinc plant, with an annual capacity of 60,000 tons of lead and 70,000 tons of zinc, was 156 million rubles.[29]

In 1977, the capital construction emphasis was on expansion and renovation of existing enterprises rather than on new construction. Special attention was devoted to the construction of the Nikolayev alumina plant, the Regar and Sayan aluminum plants, the Nadezhda copper and nickel plants in Norilsk, the facilities at the Almalyk complex, and generally increasing capacities of the petroleum, natural gas, and petrochemical industries.

New enterprises that became operational in the iron and steel industry included an oxygen converter complex at the Azovstal' plant and a rolling mill at the Nizhniy Tagil complex. Big capacities were started at the Bogatyr' lignite open pit in Kazakh U.S.S.R. In the mineral fertilizer industry, new capacities included facilities at the Balakovo chemical plant and at the Ionava nitrogen fertilizer plant. New capacities were commissioned at existing enterprises for production of zinc, aluminum, titanium, and rolled nonferrous metals.

Construction of the BAM railway continued in 1977. There were about 60,000 people working on this railway. Once BAM is completed, about 1982, the emphasis is to be transferred to the railway linking BAM with Yakutsk. The Yakut A.S.S.R. is planned to become a major mineral producer during the 1980's.

A decision was made to stop construction of the Razdan mining and chemical complex in Armenia, designed for alumina production from nepheline.[30] This project had been under construction since 1967 and was scheduled to be the second largest (after Achinsk) alumina from nepheline producer.

In 1978, it was planned to complete facilities for generating 11.9 million kilowatts of electric power, and for producing 23.7 million tons of raw coal and lignite, 15.9 million tons (Soviet standard) of mineral fertilizers, 23.4 million tons of crude iron ore, 2.2 million tons of pig iron, and 2.33 million tons of raw steel. The following tabulation gives data reported on additional production facilities, in million tons unless otherwise specified:

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Commodity[1]	1975	1976	1977	1978 (planned)
Iron ore, crude	27.3	45.0	14.1	23.4
Coal and lignite, raw	24.7	12.6	17.4	23.7
Pig iron	1.8	2.25	.6	2.2
Steel, raw	4.0	1.2	6.0	2.33
Mineral fertilizers (Soviet standard)	11.7	7.3	4.0	15.9
Cement	4.4	1.85	4.2	NA
Powerplant million kilowatts	13.0	11.9	10.0	11.9
Total capital investments in national economy million rubles	112,300	117,000	122,000	125,000

NA Not available.
[1]Includes new or expanded plant and renovation of existing facilities.

Mineral Production.—Soviet industry is organized into ministries, each controlling one sector of the economy throughout the U.S.S.R. The operation of these ministries is in turn controlled by the U.S.S.R. Council of Ministers and State Planning Committee (Gosplan U.S.S.R.).

These two bodies establish production tasks and allocate investment within the limits of the overall plans drawn by the Politburo of the Communist Party of the U.S.S.R. Mineral production of the Soviet Union is entrusted to 13 all-Union specialized ministries and 1 Committee as follows: Coal industry, ferrous metallurgy, nonferrous metallurgy, crude oil production, gas industry, geology, construction materials industry, chemical industry, petroleum and petrochemical industry, power and electrification, construction of heavy industry enterprises, construction of crude oil and gas industry enterprises, land reclamation and water resources, and State Committee for supervision of safe working practices in industry and for mine supervision.

A Soviet decree of April 1956 classified all data on production capacity and production plans of nonferrous, precious and rare metals, and some nonmetallics as State secrets. However, although the U.S.S.R. does not publish official statistics on many mineral commodities, information is available on most. Together with published information on industrial development, this information provides a basis for estimating the output of other commodities. The increase in Soviet mineral production in 1977 was largely due to additional capacity and labor rather than to productivity gains.

During 1966-75, output of aluminum grew by 120%, titanium by 150%, nickel by 94%, silicon by almost 470%, germanium by 130%, rolled copper and nickel products by 170%, and aluminum foil by 120%. Annual ore and rock mining in the nonferrous industry increased from 1,300 million tons to 2,100 million tons during the decade. The proportion of surface mining grew from 60% to 65%. The volume of nonferrous ore processing at concentration plants increased by 50% during the 1966-75 period. In 1976, 71% of the lead and 63.3% of the zinc were produced with the use of oxygen.

In 1977, nonferrous industry enterprises produced more than 70 elements and about 700 different types of industrial products. Almost all silver, bismuth, and platinum-group metals; over 20% of gold; about 30% of sulfur; and up to 10% of zinc, lead, and copper were produced as byproducts. In the surface mining of ferrous and nonferrous ores, excavations were reaching depths of 150 to 200 meters and were becoming deeper at the rate of 10 to 15 meters each year. The average depth of underground coal mining increased from 320 meters in 1965 to 410 meters in 1975, and it is increasing by 9 meters annually.

The Asian part of the U.S.S.R. (east of the Urals) provides about 45% of the total Soviet coal and lignite output, more than 35% of the crude oil, and over 30% of the electric power. The R.S.F.S.R. continues to rank first among the 15 Soviet Republics in mineral production. It produces over 80% of the gold and silver; practically all of the platinum-group metals; more than 80% of the petroleum; about two-thirds of phosphate ores and electric power; over 50% of pig iron, steel, and rolled ferrous products; and roughly 50% of the coal and natural gas.

The Ukraine continues to rank first in the output of coking coal, manganese, and iron ores, and second in natural gas. The Urals economic region, with only 3.2% of the Soviet Union's territory, accounts for one-third of the total Soviet pig iron output, 40% of steel and steel pipes, and over half of potassium fertilizers. There are 41 mines

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and 6 open pits of the nonferrous industry in the Urals. The Asian Republic of Kazakhstan, one of the most important base metal producing areas in the U.S.S.R., occupies third place in the Soviet mineral production and is the nation's leading producer of chromite, copper, lead and zinc, and rare metals. The Urals-Volga region produced nearly half of the nation's 1977 crude oil output; however, most of the U.S.S.R.'s increased petroleum production was derived from Western Siberia.

There are tremendous losses in the Soviet economy, which ought to be divided in two groups: Production losses, lowering the effectiveness of manufacture of goods; and nonproductive losses, lowering the consumption effectiveness of already manufactured goods. Soviet production losses, in turn, should be divided in two subgroups: "labor" and "material."[31]

Referred to "labor"' losses are losses of work time, including absence from work without reason, whole-day work stoppage, and idle time within the shifts.

There are three types of "material" losses: losses from defective goods, from unutilized raw materials, and from idle equipment. Many enterprises are producing goods with deviations from GOST's (All-Union State Standard) and technical specifications. At a number of enterprises there are very high percentages of wasted materials. This waste is especially high in the metal-processing industry because of the ineffective use of metal and obsolete equipment. The losses caused by idle equipment are expressed in unfinished products and also in underused capacities. Much of the idle time is due to untimely repairs and absence of spare parts. For these reasons, production technology is often disturbed, the share of manual labor grows, and the efficiency of mineral production drops.

A second group of losses is unproductive losses; that is, losses of already-manufactured products. These losses are composed of different elements, including losses in procurement and supply and protection of "unsalable goods," which do not correspond to consumer demand.

Production suffers great losses from labor turnover. Discrepancies in planning and organization are also a source of losses in the mineral industry. A great deal of time is spent on shipping and transportation and on various everyday services.

In the first half of 1977, the plan of shipments of rolled steel products in tons was fulfilled by 99.4%, but the plan was not met for 31 of the 46 products. The Cherepovets plant, for example, undershipped 323,000 tons; the Karaganda complex, 239,000 tons; the Orsk Khalilovo complex, 115,000 tons; and the Krivoy Rog plant, 130,000 tons. The disruptions of contractual obligations created pressure in material and technical supply of construction projects.[33] The Karaganda and Orsk-Khalilovo iron and steel complexes, the Zhdanov Il'ich plant, and the Kommunar and several other metallurgical plants operated poorly for a long period of time. A large number of iron and steel enterprises overspend considerable consumption per unit of production of pig iron, metal scrap, steel casting, and coke.[34] Because of poor engineering service, the coal mines do not meet production quotas.[35]

A number of nonferrous enterprises in Kazakhstan did not meet the 1976 planned targets for exploration, mine development, stripping of overburden, and permissible losses of ores in mining. Therefore, such large enterprises as the Leninogorsk and Irtysh polymetallic complexes did not produce the planned amount of copper, lead, and zinc in concentrates. Due to unsatisfactory utilization of mining equipment, and poor organization of labor and production, the plan for surface mining was not fulfilled by the Sayak and Severo-Dzhezkazgan open pits in Kazakhstan and by the open pit of the Uchaly complex in the Urals.[36]

In 1976, at the underground mines of many enterprises, including the Leninogorsk, Irtysh, and Almalyk polymetallic complexes and the Zyranov lead complex, self-propelled equipment was used poorly. As a result of the irregular and uncoordinated work of mines and concentrators, as well as violation of technological process, many beneficiation plants did not meet planned targets on extraction and allowed losses of nonferrous metals. The Alaverdy complex in Armenia operated unsatisfactorily. Labor and technological discipline was very poor, and high losses of metals were permitted. Performance of the Chimkent lead plant in Kazakhstan was the lowest in the industry. The slag processing facilities at this plant were used only 55% of the working time.[37]

Many enterprises did not operate up to their planned capacities; Achinsk alumina plant, the Revda and Orsk plants for processing nonferrous metals, and the Pol-

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evskiy cryolite plant were the lowest in the nonferrous industry. Some enterprises do not observe schedules for preventive maintenance, technical servicing of equipment is poor, and rules for technical operation of units and machines are violated and lead to accidents and idle time.[38]

In 1976, many enterprises did not fulfill the goals on production costs and exceeded norms for material, power, and labor expenditures. For example, the Revda plant for processing nonferrous metals paid a fine of 334,000 rubles for not delivering finished products according to the plan, and the Balkhash complex paid a fine of 946,000 rubles for the same reason. Many enterprises did not fulfill their goals on raising labor productivity, and at some enterprises of nonferrous industry the level of labor productivity was reduced. The Solnechnyy tin complex, the Dzhezkazgan polymetallic complex, and the Donetsk nonferrous metals processing plant employed more industrial production personnel than called for by the plan.[39]

In the last three years, the Soyuzvtortsvetmet (secondary nonferrous) enterprises did not fulfill targets on extraction of secondary aluminum. The greatest losses of metals are being allowed by the Mtsensk and Sukhodol'sk secondary nonferrous metal plants and the Gor'kiy, Tashkent, Odessa, and Perm procurement administrations of the Vtortsvetmet. Due to the insufficient work of the Soyuzvtortsvetmet on sorting and finishing copper-containing scrap and tailings necessary for the production of brass rolled products, enterprises of the Soyuztsvetmetobtabotka (processing of nonferrous metals) must use more primary copper and zinc every year.[40]

Transfer of Western technology to the Soviet Union is the most important factor in Soviet mineral industry development. Equipment used in the Soviet mineral industry is standard and mostly of the type made earlier in Western Europe and in the United States. The manufacturing of mineral industry equipment has increased substantially, but the technical standards and the quality of the equipment have fallen short of planned goals. Equipment manufacturing plants have been criticized in the Soviet press for the poor quality of their products.[41] Some enterprises produce only products that are "profitable" for them and pay little attention to the needs of the consumers.[42]

Soviet investigations show that mineral industry equipment is utilized at an average rate of 40% to 45% while the plan calls for 65%. This means that between 55% and 60% of the machinery and equipment is idle. As a result, for example, the coal industry is losing more than 180 million rubles per year.[43] At the open pits of the Ministry of Ferrous Metallurgy U.S.S.R., trucks are idle at an average of 730 units each day.[44] Performance of large imported rotary excavators at the Exibastuz coal open pits in Kazakhstan is poor.[45] The trucks at the Karatau phosphorite open pits in Kazakhstan are used at an average 25% to 37%.[46] The situation is made worse by the fact that generally mineral industry enterprises are not responsible for the low level of equipment utilization, because of the shortage of spare parts,[47] and are not much interested in improving the situation.[48]

The production of mining equipment, especially for mechanizing auxiliary processes, proceeds slowly, according to Soviet press reports, and spare parts output for mining machinery is inadequate. The available machinery did not supplant manual labor at mines. The work performed manually comprises 60% at production faces, 57% in development, and 100% in repair of workings.[49]

Because of a shortage of some needed equipment, there was a rapid increase in stocks at many establishments. Data provided by various ministries have shown that reserves of equipment above the planned limits on construction sites are not diminishing but are actually increasing. At the beginning of 1976 above-plan, uninstalled equipment constituted 36% of equipment as a whole. Much the same applied to equipment bought abroad. During the last 5 years, the value of uninstalled imported equipment has increased to 2.1 billion rubles.[50] Stocks at Soviet nonferrous industrial enterprises reached 108.4 million rubles, including 3.5 million rubles above the planned limits. Many types of equipment are unused for 10 or more years. The quality of the equipment and machines has deteriorated. At the same time, many projects could not be completed because of a shortage of equipment.[51]

In 1977, a number of mines and plants were commissioned despite numerous imperfections and inadequate equipment. Many projects have operated over a long period with lower capacities than originally planned. For example, of all the iron and steel production facilities put into operation

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in 1960 or later, 49.2% had not achieved planned indices for output, 58.6% had not reached the planned number of workers and personnel staff, 59.7% had not reached the planned level of labor productivity, and 85.3% had not reached the expected level of production costs.[52]

The large number of workers required to operate new facilities is largely connected with the inefficient development of plans for production, mechanization, and automation, the incorporation of machines and assemblies that have not yet been tested in the course of normal operations, and the incomplete planning of mechanization and automation during the construction process.[53]

The significant underutilization of capacity has also been caused by the shortage of raw materials, by the discrepancy of capacity, and by the incomplete development of production. For example, for pig iron, a shortage has been felt of sinter, pellets, and oxygen; for mineral fertilizers, ammonia, phosphorus raw materials, sulfuric acid, and potassium ores have been in short supply.[54]

The Soviets are increasingly conscious of the age and obsolescence of their machine tools and of much of their mining and metallurgical machines and equipment. Soviet industries continue to turn out obsolete models because the emphasis is on production and no time adjustments are made for retooling. The Soviets prefer not to use new and untried equipment with its inherent risk of failure and are inclined to use old and established equipment. In pig iron production, for example, 23% of the industrial production personnel are working with wornout equipment, while the figure is 43% in steel smelting and 42% in rolled steel production.[55]

Arctic Minerals.—The U.S.S.R. extracts vastly greater quantities of Arctic mineral resources than any other country. Deposits of national importance include platinum-group metals, gold, diamonds, tin, nickel, copper, cobalt, rare metals, apatite, and coal. Although mining within permafrost areas is costly, the Soviets are willing to develop these regions in order to achieve greater mineral self-sufficiency and to increase exports of these commodities.

Eastern Siberia and the Soviet Far East hold tremendous stores of useful minerals, ranging from diamonds through metals to coal. Norilsk in Krasnoyarsk Kray is the most important mineral center in the Soviet Arctic. This expanding mining and metallurgical complex, containing four underground and two open pit polymetallic mines and several coal mines as well as beneficiation and several metallurgical plants, yields about three-quarters of the platinum-group metals and more than one-half of the nickel produced in the U.S.S.R. Together with the Kola Peninsula, it contains more than 95% of the Soviet Union's platinum-group metal reserves and 80% of the nickel reserves. Platinum-group metals, cobalt, silver, selenium, tellurium, and other minor metals are recovered as byproducts from the sulfur-copper-nickel ores.

Eastern Siberia, the Yakut A.S.S.R., and the Soviet Far East contain numerous mining sites. Magadan Oblast' is the main gold production center in the U.S.S.R. with 32 placer mines, 22 dredges, and over 500 sand-washing rigs. In Yakutia, the second largest gold-producing region, the Lenzoloto trust is the leading gold-dredging enterprise in the Soviet Union. The Yakut A.S.S.R. also supplies over 90% of Soviet diamonds from the Mirnyy, Akhal, and Udachnyy deposits.

Eastern Siberia, the Yakut A.S.S.R., and the Soviet Far East also account for more than one-third of the total Soviet tin production. Tin is mined at Iul'tin, Omsukchan, and Ege-khayya, with the main center at Pevek. Tin is also produced at Deputatskiy. Several mercury and tungsten deposits have been developed in Magadan Oblast' and in the Chukotka Peninsula.

The Kola Peninsula in the European North of the U.S.S.R. contains the world's largest apatite-nepheline deposit at Khibiny. Reserves are estimated at 2,917,000 million tons of apatite (average grade about 18% P_2O_5), including some 500 million tons of proved reserves. The apatite complex produces 16 million tons of concentrate (39.4% P_2O_5) annually. Kola apatite concentrates provide over 70% of all raw materials for the production of Soviet phosphate fertilizers.

Two nonferrous metallurgical centers function in the Kola Peninsula: The Severonikel' complex, utilizing the copper-nickel ores of the Monchegorsk deposits; and the Pechenganikel' complex, based on four small copper-nickel deposits. Platinum-group metals, cobalt, silver, and a variety of other metals are produced at these complexes as byproducts. The Kola Peninsula also possesses many of the rare metals, mica, and nepheline.

Iron ore is produced at the Olenegorsk

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and Kovdor complexes. Combined output from two plants reached 10 million tons of concentrate in 1977. The Kostamush iron ore project, which is being constructed jointly with Finland, will produce over 8 million tons of pellets from 24 million tons of iron ore. The first stage of this complex is scheduled for completion in 1982. Mica is also mined in the Kola region.

The Pechora Basin, centered on Vorkuta and Inta, is the second most important coal basin in the European part of the U.S.S.R. The basin produces about 25 million tons of coal per year, including 16 million tons of coking coal. The northern part of West Siberia contains vast reserves of natural gas and crude oil and will be the main Soviet center for production of these commodities in the future.

Mineral Transportation.—About two-thirds of the total tonnage of mineral industry products moved in the U.S.S.R. in 1977 was shipped by rail. The average distances of railroad deliveries in 1976 follow: Coal and lignite, 698 kilometers; crude oil and petroleum products, 1,242 kilometers; iron and manganese ores, 715 kilometers; nonferrous ores, 895 kilometers; ferrous metals, 1,413 kilometers; cement, 512 kilometers; and mineral fertilizers, 1,059 kilometers.

About one-half of the total tonnage of crude oil and refinery products moved in the U.S.S.R. in 1976 was shipped by rail. The total length of crude oil and petroleum products trunk pipelines was 58,600 kilometers at the beginning of 1977, and the average distance of pipeline deliveries in 1976 was about 1,170 kilometers. About 70% of total pipeline capacity was utilized. The total length of trunk gas pipelines in January 1977 was 103,500 kilometers. The U.S.S.R. has several large ports for international shipping on the Black and Baltic Seas. A large port is under construction on the Sea of Japan.

The U.S.S.R. has the sixth largest merchant fleet in the world and the largest number of general cargo vessels. The systematic large-scale undercutting of prices by the growing Soviet cargo fleets is putting in jeopardy the continued existence of the regular services run by Western shipping lines. The need for hard currency will tempt the State-run Soviet fleet to resort to even more slashing of cargo rates. Soviet maritime fleet performance was expected to increase by more than 22% during the 1976-80 period. An increase of 5 million deadweight tons (dwt) in fleet capacity was planned for the same period, involving retirement of 1.6 million dwt and resulting in a net increase of 3.4 million dwt.

No country in the world has such volumes of transport by rail as the U.S.S.R., which "with a span of railway equivalent to 11% of the total world rail network accounts for 53% of the total world freight turnover carried by rail."[56] With an overall length of 138,500 kilometers, Soviet railways carry about 3,300 million tons annually. In 1976, freight turnover in the U.S.S.R. reached 3,295,400 million ton-kilometers; in the United States (where total rail network is more than double that of the Soviet Union) the comparable figure was only 1,200,000 million ton-kilometers.

The intensive use of Soviet railways is related to some extent to the inefficient use of the system. An article published in Gudok[57] reports that diesel fuel is transported both from Kremenchug to Kiyev and in the opposite direction from Polotsk to the Donbass. The Mozyr oil refinery sends gasoline to the Baltic area and to Kaliningrad Oblast', while the Polotsk oil refinery, which is located much closer to these recipients, sends the same quality gasoline to the southwestern Ukraine. There are many other examples.

The transport of petroleum products is also complicated by the distribution of oil refineries and the manner in which decisions are made with respect to their specialized functions. Miscalculations have led to a situation where kerosine is shipped from Ryazan' to Moscow while gasoline is transported from Moscow and Yaroslavl to Ryazan'. Diesel fuel from Kuybyshev is shipped westward, but such fuel is also transported from the west to the Crimea. In 1969-71, a pipeline was laid from Guryev to Kuybyshev, but 3 years later it was decided to lay another pipeline from Kuybyshev to Tikhoretsk (in the Caucasus) and to pump the petroleum in the opposite direction.

Over 38% of all petroleum products are transported by rail in the U.S.S.R., in the United States the comparable figure is 1.5%. According to Soviet data, the situation in other branches of the Soviet economy (particularly the mineral industry) is not much better. This helps to explain the astronomical ton-kilometer rail transport statistics of the U.S.S.R.

The coal-carrying railroads are supplied extremely irregularly with gondolas.[58]

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Soviet railway transportation

(Million metric tons unless otherwise specified)

Commodity	Actual		1980 planned	Increase, percentage	
	1970	1975		1971-75 (actual)	1976-80 (planned)
Coal and lignite, raw:					
Production	624.1	701.3	805.0	112.4	114.8
Transportation	611.2	713.0	830.0	116.7	116.4
Average distance, kilometers	693	696	725	100.8	104
Crude oil (including condensate):					
Production	353.0	490.8	640	139.0	130.4
Transportation, total	374.2	516.3	650	137.9	125.9
Of this:					
Railway	59.6	58.3	50	97.8	85.8
Pipeline	314.6	458.0	600	145.6	131.0
Average distance, kilometers	916	1,455	1,915	159	131
Of this:					
Railway, do.	1,400	1,930	1,930	137	100
Pipeline, do.	825	1,390	1,925	168	138
Petroleum products:					
Transportation, total	267.2	369.0	489	138.2	132.5
Of this:					
Railway	241.9	329.4	424	136.2	128.7
Pipeline	25.3	39.6	65	156.5	164.1
Average distance, kilometers	1,100	1,200	985	110	82
Of this:					
Railway, do.	1,120	1,120	1,045	100	93
Pipeline, do.	868	682	584	77	86
Iron ore:					
Production	195.5	232.8	276.5	119.1	118.8
Transportation	245.6	307.8	390.0	125.3	126.7
Average distance, kilometers	690	753	790	105.2	105
Coke:					
Transportation	32.7	34.6	41.5	105.8	119.9
Average distance, kilometers	719	850	820	118.4	97
Pig iron and steel:					
Production:					
Pig iron	85.9	103.0	122.0	119.9	118.4
Steel, raw	115.9	141.3	168.0	121.9	118.9
Steel, rolled	92.5	115.0	131.7	124.3	114.5
Steel pipe	12.4	16.0	19.8	129.0	123.8
Transportation	141.4	182.7	218.0	129.2	119.3
Average distance, kilometers	1,355	1,420	1,420	104.5	100.0
Mineral fertilizers (Soviet standard):					
Production	55.4	90.2	143.0	162.8	158.5
Transportation	70.7	106.0	157.5	149.9	148.6
Average distance, kilometers	1,000	1,055	985	105.5	93.6
Construction materials:					
Transportation	687.6	942.6	1,090.0	137.1	115.6
Average distance, kilometers	435	465	485	106.8	104.2

Source: Zheleznodorozhnyy transport (Railway Transportation). Moscow, No. 6, June 1977, pp. 81-88.

Table 1.—U.S.S.R.: Estimated[1] production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Aluminum:			
Ores and concentrates:			
Bauxite, 26% to 57% alumina	4,400	4,500	4,600
Nepheline concentrate, 25% to 30% alumina	3,400	3,500	3,600
Alunite ore, 16% to 18% alumina	600	600	600
Alumina	2,400	2,500	2,600
Metal, smelter:			
Primary	1,530	1,600	1,640
Secondary	150	150	150
Antimony, mine output, metal content, metric tons	7,500	7,700	7,900

See footnotes at end of table.

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Table 1.—U.S.S.R.: Estimated[1] production of mineral commodities —Continued

(Thousand metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS —Continued			
Arsenic, white (As_2O_3) metric tons	7,350	7,400	7,500
Beryllium, beryl, cobbed, 10% to 20% BeO do	1,600	1,650	1,700
Bismuth, mine output, metal content do	60	60	65
Cadmium, smelter do	2,650	2,700	2,750
Chromium, chromite ore, 30% to 56% Cr_2O_3	2,080	2,120	2,180
Cobalt:			
Mine output, metal content metric tons	1,800	1,800	1,900
Smelter do	1,800	1,800	1,900
Copper:			
Ore:			
Gross weight, 0.5% to 2% Cu	76,500	80,000	83,000
Metal content, recoverable	765	800	830
Blister:			
Primary	765	800	830
Secondary	160	165	170
Refined:			
Primary	725	760	790
Secondary	160	160	170
Gold, mine output, metal content thousand troy ounces	7,500	7,700	7,850
Iron and steel:[2]			
Iron ore, 55% to 63% Fe	232,803	239,109	239,716
Agglomerated products:			
Sinter	151,943	153,251	158,195
Pellets	27,209	31,398	36,170
Pig iron and blast furnace ferroalloys:			
Pig iron for steelmaking[e]	93,803	[e]96,033	[e]97,841
Foundry pig iron[e]	8,156	[e]8,371	[e]8,552
Spiegeleisen	104	[e]102	[e]100
Ferromanganese[e]	878	[e]850	[e]850
Other blast furnace ferroalloys[e]	27	[e]28	[e]25
Total	102,968	105,384	107,368
Electric furnace ferroalloys[e]	2,079	2,085	2,095
Crude steel:[3]			
Ingots	132,278	[e]135,684	[e]137,417
Steel for castings	9,047	[e]9,121	[e]9,238
Total	141,325	144,805	146,655
Semimanufactures:			
Sections	37,680	38,084	38,697
Wire rod	8,283	8,348	8,349
Pipe stock	5,624	5,872	5,845
Tubes from ingots	1,656	1,688	1,811
Plates and sheets:			
Over 5 millimeters thick	12,933	13,640	13,852
Other	18,111	18,929	18,907
Total plates and sheets	31,044	32,569	32,759
Strip	10,072	10,603	10,714
Railroad track material	3,816	3,945	3,943
Wheels, tires, axles	1,124	1,190	1,118
Unspecified shapes for sale	912	745	631
Other and unspecified	73	69	68
Total semimanufactures	100,284	103,118	103,935
Selected end products:[4]			
Welded pipes and tubes	9,499	10,067	10,116
Seamless pipes and tubes	6,464	6,738	6,901
Total pipes and tubes	15,963	16,805	17,017
Cold-rolled sheet	6,809	6,943	7,054
Tinplate	613	[e]612	[e]612
Galvanized sheet	680	[3]660	[e]660
Electrical sheet	1,124	1,151	1,154
Cold-reduced strip	398	435	431
Wire, plain	3,818	[3]3,850	[3]3,850
Lead:			
Mine output, recoverable metal content	[r]480	[r]500	510
Smelter:			
Primary	480	500	510
Secondary	95	100	100
Magnesium including secondary	60	63	65
Manganese ore, gross weight[5]	[r]8,459	8,636	8,500

See footnotes at end of table.

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Table 1.—U.S.S.R.: Estimated[1] production of mineral commodities —Continued

(Thousand metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS —Continued			
Mercury metal including secondary ---- 76-pound flasks	55,000	56,000	58,000
Molybdenum, mine output, metal content ---- metric tons	9,060	9,350	9,700
Nickel:			
Mine output, metal content	[r]135	135	142
Smelter	[r]172	[r]155	162
Platinum, mine output, metal content ---- thousand troy ounces	2,650	2,800	2,900
Silver metal including secondary ---- do	43,000	44,000	45,000
Tin:			
Mine output, recoverable metal content ---- metric tons	30,000	31,000	32,000
Smelter:			
Primary ---- do	30,000	31,000	32,000
Secondary ---- do	10,000	11,000	12,000
Titanium metal ---- do	30,000	32,000	35,000
Tungsten concentrates, contained tungsten ---- do	7,800	8,000	8,200
Vanadium ---- do	8,000	8,000	9,000
Zinc:			
Mine output, recoverable metal content	690	720	735
Metal:			
Primary	690	720	735
Secondary	75	80	80
NONMETALS			
Asbestos	1,900	2,290	2,460
Barite	350	400	450
Boron minerals and compounds, B_2O_3 content	80	90	90
Cement, hydraulic[5]	[r]122,057	124,246	127,000
Clays, kaolin (including china clay)	2,200	2,200	2,300
Corundum, natural ---- metric tons	7,500	7,500	8,000
Diamond:			
Gem ---- thousand carats	1,950	2,000	2,100
Industrial ---- do	7,750	7,900	8,200
Total ---- do	9,700	9,900	10,300
Diatomite	410	420	430
Feldspar	280	280	290
Fertilizer materials:			
Crude:			
Nitrogen compounds, N content[5]	8,535	[r]8,608	9,114
Phosphatic:			
Apatite:			
Ore, 17.7% P_2O_5	35,600	37,000	41.000
Concentrate, 39.4% P_2O_5	15,300	[r]15,400	15,500
Sedimentary rock:			
Ore, 13% P_2O_5	30,000	34,000	35,000
Concentrate, 19% to 25% P_2O_5	15,000	17,000	17,500
Potassic potash, K_2O equivalent[5]	7,944	[r]8,310	8,347
Manufactured:			
Nitrogenous	41,628	41,970	44,450
Phosphatic:			
Metal, gross weight	5,573	4,372	4,320
Other, gross weight	[r]23,816	[r]25,844	27,822
Potassic, gross weight	19,097	19,977	20,063
Other and unspecified, gross weight	88	81	97
Total	90,202	92,244	96,752
Fluorspar	475	490	500
Graphite	90	95	95
Gypsum	5,000	5,000	5,200
Lime, dead-burned	23,000	23,000	23,500
Magnesite:			
Crude	3,600	3,600	3,700
Marketable product	1,800	1,800	1,850
Mica	42	43	44
Pyrite:			
Gross weight	[r]6,800	[r]7,000	7,000
Sulfur content	[r]3,200	[r]3,300	3,300
Salt, all types	13,700	14,000	15,500
Sulfur, elemental (excluding sulfur content of pyrite):			
From ores	[r]2,190	[r]2,700	2,900
Byproduct recovered	[r]2,590	[r]3,140	3,340
Talc	420	440	450
MINERAL FUELS AND RELATED MATERIALS			
Coal:[6]			
Anthracite	76,965	77,739	79,000
Bituminous	460,682	470,279	488,000
Total "hard" coal	[r]537,647	548,018	557,000

See footnotes at end of table.

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Table 1.—U.S.S.R.: Estimated[1] production of mineral commodities —Continued

(Thousand metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS —Continued			
Coal[6] —Continued			
Lignite and brown	163,633	163,504	165,000
Coke: Oven, beehive, breeze, and gas coke[7]	83,543	e84,400	e86,000
Fuel briquets:[7]			
From anthracite and bituminous coal	1,350	e1,350	e715
From lignite and brown coal	e6,987	e7,204	e7,840
Total	e8,337	e8,554	e8,555
Gas, natural:			
Gross production million cubic feet	10,760,000	11,950,000	12,884,000
Marketed production[5] do	r10,205,890	11,334,295	12,218,923
Peat:			
Agricultural use	131,600	131,600	131,600
Fuel use	60,000	60,000	60,000
Oil shale	32,500	33,000	33,500
Petroleum:			
Crude:			
As reported, gravimetric units[5]	r490,801	r519,677	546,000
Converted, volumetric units thousand 42-gallon barrels	r3,607,387	3,819,626	4,013,100
Refined products[8 9]	372,649	383,190	392,722

eEstimate. pPreliminary. rRevised.

[1]Estimate unless otherwise noted.

[2]Sources (except where otherwise noted): United Nations Economic Commission for Europe, Annual Bulletin of Steel Statistics for Europe 1977, v. 5, New York 1978, p. 21; Quarterly Bulletin of Steel Statistics for Europe, v. 29, No. 4, 1979, pp. 19, 29.

[3]Estimates for 1976 and 1977 are based upon reported results for the first 6 months of 1976.

[4]Items reported under this heading are produced from semimanufactures listed above and possibly also from similar imported semimanufactures. Therefore, these data are not additive to total semimanufactures listed.

[5]Reported in Soviet sources.

[6]Run-of-mine coal: the average ash content of coal shipped from mines was 20.2%, and the average calorific value was a little more than 5,000 kilocalories per kilogram (9,000 Btu/lb) in 1977.

[7]United Nations. World Energy Supplies 1973-1978. Series J, No. 22, New York, 1979, p. 125.

[8]Not distributed by type, and therefore not suitable for conversion to volumetric units. Data include all energy products, some nonenergy products, and refinery fuel but exclude petrochemical feedstocks, paraffin, petroleum coke, white spirit, unspecified minor nonenergy products, and refinery losses.

[9]United Nations. World Energy Supplies 1973-78. Series J, No. 22, New York, 1979, p. K48.

TRADE

Foreign trade is administered by the Foreign Trade Ministry, operating through more than 60 subsidiary organizations. Political objectives exert a strong and often determining influence. Trade continues to be oriented towards imports of large quantities of Western industrial machinery and technology, including complete industrial plants. Also important are the substantial grain imports. Exports of mineral commodities help pay for these imports, even though there are domestic shortages in almost all mineral commodities exported.

Reportedly, the Soviet Union is making changes in its foreign trade system to make organizations responsible to industrial ministries rather than just to the Foreign Trade Ministry. The amount of statistical data published on the Soviet economy has tended to diminish, for example, the Foreign Trade Statistical Yearbook for 1976 has no data on trade of many nonferrous metals and some nonmetallic minerals.

In recent years, the Soviet Union has moved into a substantial trade deficit with the industrialized West. This has been financed by overseas borrowing (estimated at about $7 billion in 1977). France, Britain, and Italy have all supplied the U.S.S.R. with general credit lines in the past. Predictions are that Soviet credit obligation could reach more than $10 billion by 1980, and some experts suggest that the U.S.S.R. could have trouble meeting these obligations at that time. About 80% of the foreign exchange needs are covered by exports of fuels, metals, and nonmetallic minerals.

Soviet official foreign trade turnover (exports and imports) in 1977 reached 63.4 billion rubles, an increase for the year of 6.6 billion rubles, or 11.6%. The increase reflected mainly higher prices. Whereas in 1976 official import was greater than export by 700 million rubles, the balance became positive in 1977. Export exceeded import by more than 3 billion rubles, so that the net

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result for the 2 years is a positive balance of more than 2.4 billion rubles. The Soviet Union trades with 118 countries, and in 92 cases the trade is based on intergovernmental agreements. The trade continues to be oriented towards imports of large quantities of Western industrial machinery and technology (including complete industrial plants), food stuffs and raw materials for their production, manufactured consumer goods, ores, metals, and chemicals. Machinery and equipment occupy the leading place in Soviet imports and represent about 40% of the total official import.

Soviet trade with the industrially developed countries decreased slightly in 1977, primarily owing to a large reduction in grain imports. Trade with these countries totaled $27.1 billion, almost the same as in 1976; however, this was 29% of the country's total foreign trade compared with 33% in 1976.

In Soviet economic relations with the industrially developed countries, the Soviet Union prefers the development of trade on a compensation basis, in which the Western companies accept payment in production or in kind, rather than in currency.

According to Soviet sources, the U.S.S.R. had concluded compensation agreements with Western and Japanese companies to supply equipment for construction of more than 60 major projects in such industries as chemical, coal, petroleum, gas, and timber.

The Soviet Union's foreign trade with developing countries rose from $9.57 billion in 1976 to $12.17 billion in 1977. Trade with these countries accounted for 13% of total Soviet trade compared with 11.6% in 1976. Exports to developing countries in 1977 amounted to $7.8 billion.

The largest volume of Soviet trade continues to be with the Federal Republic of Germany, followed by Japan, the United States, and Finland. Foreign trade shipments amounted to 371.5 million tons in 1976; by 1980, they were expected to be 500 million tons. Soviet official foreign trade turnover (exports plus imports) was expected to reach a value of 70 billion rubles in 1980. Most of the Soviet mineral trade has been with nonmarket economy countries, but the U.S.S.R. is now aiming to increase exports to Western countries and especially to the United States. The number of Soviet-controlled firms in the West continues to grow, mostly in marketing, shipping, and fishing. In Vienna, a new joint Soviet-Austrian trading company, Intercom, was established in 1977 to trade in raw materials, mainly ores, coal, and chemical products.

The Soviet Union provides nearly 100% of the other Comecon countries' imports of crude oil, natural gas, pig iron, and electric power; up to 90% of their iron ore; two-thirds of their petroleum products, rolled ferrous metals, and phosphorus fertilizers; and 60% of their coal and manganese ore.

Imports of mineral commodities in which the U.S.S.R. was not self-sufficient in 1977 included ferrous semimanufactures, steel pipe, bauxite and alumina, tin, tungsten concentrates, and high-quality talc and mica. The U.S.S.R. will be importing 70,000 tons of lead ore and 75,000 tons of zinc ore from Iran through 1980. Petroleum and natural gas imports came from the Middle East and North Africa in exchange for manufactured goods and services.

Table 2.—U.S.S.R.: Exports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Bauxite	r297	5,282	All to Spain.
Metal including alloys:			
Scrap	r23,368	46,067	United States 29,394; Austria 10,709; United Kingdom 5,781.
Unwrought[2]	[3]502,365	356,458	Hungary 124,887; Czechoslovakia 78,000; Japan 68,760; Yugoslavia 29,185.
Semimanufactures[2]	[3]101,510	9,917	Yugoslavia 4,416; Poland 2,525; Finland 1,447.
Arsenic, acid	--	55	All to Yugoslavia.
Chromium:			
Chromite[3] thousand tons	1,171	975	West Germany 147; Sweden 138; Poland 121; United States 118.
Trioxide	r [3]5,247	[3]6,155	West Germany 1,018; France 970; Japan 825; Czechoslovakia 500[3].

See footnotes at end of table.

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Table 2.—U.S.S.R.: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Copper:			
Copper sulfate[3]	20,361	21,544	Bulgaria 8,600; Hungary 3,080; Switzerland 2,650.
Metal including alloys:			
Scrap	r767	103	All to United Kingdom.
Unwrought[2]	209,859	101,136	Czechoslovakia 41,000; West Germany 23,582; United Kingdom 9,026.
Semimanufactures[2]	17,683	3,876	Yugoslavia 1,972; Poland 1864.
Iron and steel:			
Ore and concentrate[3] thousand tons	43,626	43,126	Czechoslovakia 12,755; Poland 11,828; Romania 5,135; Hungary 4,126.
Metal:			
Scrap[3] do	1,139	1,837	East Germany 511; Italy 349; Yugoslavia 220; Japan 177.
Pig iron[3] do	4,729	4,527	Poland 1,517; Czechoslovakia 874; East Germany 637.
Ferroalloys[3]	396,867	418,124	Czechoslovakia 105,995; Romania 100,671; Hungary 43,507.
Steel ingots and other primary forms thousand tons	2,170	1,559	Bulgaria 1,009[3]; Hungary 235; Yugoslavia 203.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	1,969	1,367	East Germany 712; Hungary 518; Bulgaria 90.
Plates and sheets do	2,874	1,055	East Germany 499; Hungary 265; Bulgaria 147; Poland 107.
Hoop and strip do	9	13	Bulgaria 9; Yugoslavia 3.
Rails and accessories do	371	2	Mainly to Yugoslavia.
Wire[3] do	63	74	Cuba 29; East Germany 12; Bulgaria 10.
Tubes and pipes[3] do	339	594	East Germany 182; Cuba 47; Bulgaria 15.
Unspecified do	r87	2,843	East Germany 1,600[e]; Poland 514.
Total[3] do	5,712	5,948	
Lead metal, unwrought[2]	[3]98,889	35,978	Czechoslovakia 25,000; Finland 6,980; Poland 3,998.
Magnesium metal, all forms[2]	[3]11,380	5,221	West Germany 3,200; Australia 596; Yugoslavia 502.
Manganese ore and concentrate[3] thousand tons	1,411	1,342	Poland 482; Czechoslovakia 356; East Germany 185.
Mercury 76-pound flasks	r6,382	580	Australia 319; Sweden 261.
Nickel:			
Matte and speiss	r236	1,101	Sweden 1,080.
Metal including alloys:			
Scrap	r969	544	Austria 505.
Unwrought	r16,772	17,445	Czechoslovakia 6,686; Japan 2,950; France 2,922; West Germany 2,121.
Semimanufactures	--	29	All to Yugoslavia.
Platinum metal, unmarked or partly worked, not rolled value, thousands	r$203,874	$190,563	Japan $89,128; United States $55,663; West Germany $17,260.
Silver metal, scrap do	--	$165	All to West Germany.
Zinc:			
Oxide	r253	622	France 572; Japan 50.
Metal including alloys, unwrought[2]	[3]100,575	27,331	Czechoslovakia 21,000; Yugoslavia 1,456; Poland 852.
Other:			
Ash and residues, nonferrous[4]	r24,842	36,760	Austria 35,428.
Oxides, hydroxides, peroxides[4]	r1,010	841	United Kingdom 214; West Germany 174; Japan 135.
Metals:			
Metalloids	r2,515	1,479	Japan 1,345.
Alkali and rare earth metals	r318	139	United States 52; Belgium-Luxembourg 50.
Base metals, all forms, n.e.s.[4]	r8,931	4,388	West Germany 2,154; Sweden 719.
Nonferrous metals and alloys:[5]			
Unwrought	43,176	485,242	East Germany 251,672; Poland 33,114; Hungary 17,432; Czechoslovakia 12,880.
Semimanufactures	7,037	125,504	Hungary 28,448; Poland 22,157; Cuba 15,792; Bulgaria 12,390.
NONMETALS			
Abrasives:			
Hard alloys[3]	82	100	Romania 70; Bulgaria 22.
Pumice, emery, natural corundum	r857	623	All to Hungary.

See footnotes at end of table.

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Table 2.—U.S.S.R.: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Abrasives —Continued			
Powder and dust of semiprecious and precious stones value, thousands	r$197	$185	Belgium-Luxembourg $92; Yugoslavia $91.
Grinding and polishing stones[4]	7	6	Yugoslavia 3; Finland 3.
Asbestos	[3]613,303	389,368	Poland 70,192; Japan 54,335; France 47,169; West Germany 41,296.
Boron:			
Crude, natural borates	r1,649	4,174	Japan 4,063.
Oxide and acid	r2,384	5,143	Japan 2,466; Hungary 1,542[3]; Yugoslavia 650[3].
Cement, hydraulic[3] thousand tons	3,322	2,882	Hungary 478; Czechoslovakia 423; Libya 280.
Clay and clay products:			
Crude	r84,089	65,850	Poland 64,917.
Products:			
Refractory including magnesite products[3]	126,714	132,519	Bulgaria 25,292; Romania 23,548; Cuba 21,824.
Nonrefractory	NA	5,891	All to Finland.
Diamond:			
Gem, not set or strung value, thousands	$100,627	$521,977	United Kingdom $372,404; Belgium-Luxembourg $68,090.
Industrial do	$1,464	$1,377	Belgium-Luxembourg $766; United States $610.
Feldspar, fluorspar, fluorite	r1,503	156	All to Hungary.
Fertilizer materials:			
Crude, phosphatic thousand tons	[3]5,856	4,284	East Germany 1,375; Poland 598; Czechoslovakia 496; West Germany 495; Sweden 228.
Manufactured:[3]			
Nitrogenous do	1,311	1,694	Cuba 472; Czechoslovakia 263; Turkey 186; North Vietnam 161.
Phosphatic do	530	533	Cuba 185; Bulgaria 161; Hungary 143.
Potassic do	5,986	5,567	Poland 2,647; Hungary 528; Czechoslovakia 369; Japan 290.
Ammonia do	88	163	France 122; Cuba 14.
Graphite	r10,929	12,739	Japan 5,439; Poland 4,211; United States 1,233.
Gypsum and plasters	r290,973	206,433	Sweden 92,800[3]; Denmark 45,800[3]; Norway 37,488; Finland 28,520[3].
Iodine	r26	28	All to Hungary.
Magnesite, calcined	r23,262	24,212	Hungary 11,691; Japan 4,779; Netherlands 3,982; Sweden 3,760.
Pigment	r915	1,164	All to Hungary.
Precious and semiprecious stones value, thousands	r$2,508	$3,488	Spain $2,364; Japan $349; Belgium-Luxembourg $347.
Pyrite, not roasted[3] thousand tons	1,260	873	Italy 200; East Germany 127; Hungary 81; West Germany 72.
Salt[3]	320,704	429,767	Czechoslovakia 129,828; Hungary 114,152; Finland 37,577.
Sodium and potassium compounds:[3]			
Caustic soda	39,274	43,814	Cuba 25,560; North Vietnam 2,619.
Soda ash	62,776	60,345	Czechoslovakia 23,872; Cuba 10,029; Italy 9,453; Iran 4,372.
Stone, sand and gravel:			
Dimension stone	r17,935	12,146	Italy 4,782; West Germany 4,367.
Limestone	r3,445	5,908	All to Norway.
Quartz and quartzite	r3,156	[4]149	All to Japan.
Sand	r355	325	All to Hungary.
Sulfur:			
Elemental	[3]440,978	52,179	Hungary 27,924; West Germany 11,972.
Sulfuric acid[3]	121,054	65,037	Czechoslovakia 53,750.
Other:			
Crude:			
Meerschaum, amber, jet	r6	7	All to West Germany.
Other	r71,497	56,363	Belgium-Luxembourg 19,388; Italy 11,132; Spain 10,780.
Slag, dross, other waste	--	4,250	All to Italy.
Oxides of strontium, barium, magnesium	r6,770	5,356	Finland 4,581; United States 320.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black[3]	86,635	86,279	East Germany 26,162; Bulgaria 16,840; Czechoslovakia 15,837.
Coal, anthracite and bituminous[3] thousand tons	25,951	26,896	Bulgaria 6,083; East Germany 3,837; Japan 3,224; Czechoslovakia 2,892.
Coke do	[3]4,208	[2]4,200	East Germany 1,085; Romania 1,000[2]; Hungary 795; Finland 646.
Gas, natural[3] million cubic feet	672,141	910,408	Czechoslovakia 151,393; West Germany 140,411; Italy 131,370; East Germany 118,975.

See footnotes at end of table.

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Table 2.—U.S.S.R.: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Peat and briquets ____ thousand tons__	r63	109	West Germany 32; Italy 20; France 18.
Petroleum:			
Crude ____ thousand 42-gallon barrels__	[3]684,064	[3]814,307	Czechoslovakia 119,923; East Germany 117,688; Poland 85,591; Bulgaria 73,662.
Refinery products:			
Gasoline ____do____	50,702	24,803	Netherlands 9,665; United Kingdom 4,471; Italy 4,080.
Kerosine and jet fuel____do____	20,336	4,185	West Germany 1,225; Hungary 1,151; Denmark 495; Sweden 437.
Distillate fuel oil ____do____	118,539	97,161	West Germany 29,855; Switzerland 11,265; Finland 10,548.
Residual fuel oil ____do____	79,793	54,023	Sweden 16,637; Finland 9,371; Italy 7,773.
Lubricants____do____	2,301	217	Finland 159.
Other:			
Liquefied petroleum gas ____do____	1,303	291	Hungary 221; Austria 70.[3]
Mineral jelly and wax ____do____	523	158	Finland 67; Italy 47.
Nonlubricating oils____do____	NA	6,432	West Germany 6,397.
Petroleum coke ____do____	843	609	Japan 301; Italy 267.
Bitumen and other residues__do____	134	28	All to Italy.
Unspecified ____do____	1,746	87,478	Poland 11,936.
Total ____do____	276,220	275,385	
Mineral tar and other coal-, petroleum-, and gas-derived crude chemicals[3] ___ thousand tons__	507	381	East Germany 46; Italy 44; France 42; Austria 15.

[e]Estimate. [r]Revised. NA Not available.

[1]In previous editions of this yearbook chapter, data on exports of the U.S.S.R. were derived wholly from official Soviet trade returns; however, beginning in 1976, these official trade returns no longer included figures for a number of mineral commodities. As a result of this curtailment in publication of detailed statistics, it has proven necessary to use data of trading partner countries in order to provide coverage for a number of commodities. Unless otherwise specified, data in this edition are partly or wholly compiled from information on trading partner country imports from the U.S.S.R. appearing in (1) the 1976 edition of the Supplement to the World Trade Annual, v. 1, published by Walker and Company, New York, utilizing data prepared by the Statistical Office of the United Nations from official trade returns of Australia, Austria, Belgium-Luxembourg, Canada, Denmark, Finland, France, Federal Republic of Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, the United States (including Puerto Rico), and Yugoslavia; and (2) official trade statistics of Bulgaria, Czechoslovakia, Hungary, and Poland. As such, the figures presented may represent only a part of total Soviet exports.

[2]Subsequent to 1975, official Soviet trade returns do not provide detail regarding total exports or the distribution by trading partners of this metal; instead they provide only an aggregate for total nonferrous metals, broken down into only two categories—unwrought and semimanufactures. Figures presented here represent officially reported Soviet exports for 1975 and the summation of trading partners' reported imports from the U.S.S.R. for 1976. (See footnote 1 above for detailed list of trading partners included.)

[3]Source: Official trade returns of the U.S.S.R.

[4]Partial figure; some trading partners record additional imports from the U.S.S.R., but only in terms of value.

[5]Figures presented here represent the difference between reported Soviet exports of all nonferrous metals (divided only as to the degree of processing) and detail listed above individually under aluminum, copper, lead, magnesium, mercury, nickel, and zinc, as indicated by footnote 2. For 1975, this figure should represent only metals other than those in the foregoing list together with iron and steel; for 1976, this figure should represent not only these other metals but also quantities of the metals in the foregoing list that were exported to countries not listed in footnote 1.

Table 3.—U.S.S.R.: Imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite[2]____ thousand tons__	3,477	3,524	Guinea 2,484; Yugoslavia 635; Greece 405.
Alumina____do____	[3]1,029	508	Hungary 333; Italy 146.
Metal and alloys, all forms[3] ____	[3]3,541	6,628	West Germany 3,403; Norway 812; Japan 697.
Copper:			
Ore and concentrate____	22,248	85,443	Canada 49,644;[4] Cyprus 30,304;[2] Morocco 5,495.[2]
Metal and alloys:[3]			
Unwrought ____	[3]8,532	10,713	All from Poland.
Semimanufactures____	[3]27,094	20,655	Yugoslavia 12,330; West Germany 3,024; Poland 2,878.

See footnotes at end of table.

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Table 3.—U.S.S.R.: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Iron and steel:			
Scrap thousand tons	14	19	Mongolia 18.[2]
Pig iron[2] do	135	229	India 159; North Korea 34.
Ferroalloys[2] do	40	33	Norway 18; North Korea 3.
Steel, primary forms do	2	7	France 3; Belgium-Luxembourg 3.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	r1,512	[5]1,996	Japan 1,118;[5] Belgium-Luxembourg 292; Spain 174.
Plates and sheets do	r1,868	[5]1,901	West Germany 894; Belgium-Luxembourg 270; Japan 218.[5]
Hoop and strip[2] do	r183	242	West Germany 188.
Wire[2] do	11	24	Belgium-Luxembourg 10; West Germany 3.
Tubes and pipes[2] do	2,723	2,985	West Germany 875; Italy 585; Japan 578; Romania 210.
Castings and forgings do	r1	4	Mostly from Poland.
Unspecified do	r1,363	795	Poland 138; Czechoslovakia 115.
Total[2] do	r7,661	7,947	
Lead:			
Ore and concentrate	54,644	60,159	Iran 41,544;[2] Italy 8,480; Yugoslavia 5,372.
Oxide	r800	425	All from North Korea.
Metal and alloy, unwrought[3]	[2]56,700	21,905	Belgium-Luxembourg 8,950; West Germany 7,001.
Nickel metal and alloys, semimanufactures	r23	[6]121	United States 95; West Germany 22.
Platinum-group metals and silver:			
Ore and concentrate value, thousands	--	$241	All from Canada.
Metal:			
Platinum, unwrought or partly worked, not rolled do	r$241	$406	United States $358; West Germany $35.
Silver, unworked or partly worked do	r$15	$119	Japan $70; Switzerland $49.
Silver metal troy ounces	NA	32,150	All from Poland.
Tin:			
Ore and concentrate	468	1,812	All from Bolivia.
Oxide	--	60	All from United Kingdom.
Metal, unwrought, unalloyed[3]	[2]9,654	1,063	Do.
Titanium oxide	r3,031	1,675	All from West Germany.
Tungsten:			
Ore and concentrate	[2]8,120	1,035	Austria 787; Netherlands 215.
Middlings	[2]154	NA	
Metal, all forms[3]	r50	r37	Japan 33.
Vanadium ore and concentrate	NA	30	All from West Germany.
Zinc:			
Ore and concentrate	48,983	48,602	Iran 41,102;[2] Belgium-Luxembourg 7,500.
Metal and alloys:[3]			
Unwrought	[2]49,080	35,985	Poland 14,776; Japan 9,720; Norway 3,999.
Semimanufactures	[2]13,749	1,521	All from Poland.
Other:			
Oxides, hydroxides, peroxides	r402	1,018	United States 591; Finland 300.
Metals:			
Metalloids	r32,064	28,783	Norway 18,437; Yugoslavia 9,445.
Base metals, all forms, n.e.s	1,493	[6]741	Yugoslavia 325; United Kingdom 180; France 162.
Nonferrous metals and alloys:[7]			
Unwrought	3,717	6,883	North Korea 3,348; Poland 1,504 Bulgaria 1,500.
Semimanufactures	4,781	16,045	North Korea 9,517; Bulgaria 6,528.
NONMETALS			
Abrasives:			
Dust and powder of gems value, thousands	r$75	$93	All from Belgium-Luxembourg.
Grinding and polishing wheels and stones	r1,856	[6]2,241	Austria 520; Japan 385; West Germany 374; Italy 334.
Barite	[2]329,544	43,694	Yugoslavia 24,197; Netherlands 24,197.
Cement, hydraulic[2] thousand tons	811	552	North Korea 275; Mongolia 28.
Clay and clay products:			
Crude	r1,754	369	All from United Kingdom.
Clay products:			
Refractory	r70,222	[6]36,158	Yugoslavia 17,674; Poland 5,518; West Germany 5,101.
Nonrefractory	r3,539	[6]4,461	Greece 3,271; Finland 503; Italy 400.
Diamond:			
Gem, not set or strung value, thousands	r$688	$141	All from Belgium-Luxembourg.
Industrial do	r$1,886	$1,394	Belgium-Luxembourg $1,378.

See footnotes at end of table.

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Table 3.—U.S.S.R.: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Diatomite and other infusorial earth	NA	167	All from Iceland.
Fertilizer materials, manufactured:			
Nitrogenous	[2]15,426	47,049	Afghanistan 29,729;[2] North Korea 15,077.[2]
Phosphatic	[2]136,654	50,300	All from Sweden.
Gypsum and plasters	[r]114	126,725	All from United States.
Magnesite:			
Powder[2]	406,503	378,955	North Korea 342,835.
Other	[2]23,645	20,570	Greece 10,500; Yugoslavia 10,070.
Mica, all forms	[2]498	2	All from United States.
Pigments, iron oxides, processed	[r]2,607	639	All from West Germany.
Precious and semiprecious stones value, thousands	[r]$2,696	$828	France $504; Switzerland $288.
Salt[2]	99,921	84,837	All from Mainland China.
Sodium and potassium compounds:[2]			
Caustic soda	7,519	10,015	West Germany 7,700; East Germany 1,200.
Soda ash	567,637	550,967	Bulgaria 427,611; Romania 79,792; Poland 41,064.
Stone, sand and gravel:			
Dimension stone, worked	[r]132	653	Yugoslavia 473; Italy 180.
Quartz and quartzite	--	29	All from Italy.
Sulfur:			
Elemental thousand tons	[2]690	664	All from Poland.
Sulfuric acid	[r]29	12,420	Poland 12,405.
Talc	[2]90,950	7,278	Finland 4,004; Spain 3,274.
Other:			
Crude, unspecified	--	856	All from Japan.
Oxides of strontium, barium, magnesium	[r]15,403	17,517	Japan 10,600; France 3,741; United States 2,600.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black[2]	1,291	97	NA.
Coal:			
Bituminous[2] thousand tons	9,818	9,376	All from Poland.
Lignite do.	[r]26	18	All from Hungary.
Coke do.	[2]919	888	All from Poland.
Gas, natural[2] million cubic feet	438,500	416,181	Iran 327,719; Afghanistan 88,286.
Petroleum:			
Crude[2] thousand 42-gallon barrels	48,521	47,622	Iraq 43,384; Syria 3,123; Egypt 1,115.
Refinery products:[3]			
Gasoline do.	[2]4,060	3	All from Yugoslavia.
Kerosine do.	[2]1,404	348	Italy 224; Hungary 103.
Distillate fuel oil do.	[2]914	376	Hungary 116; Spain 95; Canada 85.
Residual fuel oil do.	[r]19	67	Greece 56.
Lubricants do.	[2]848	[e]91	Finland 48; Netherlands 22.
Other:			
Mineral jelly and wax do.	[r]1	1	All from Japan.
Nonlubricating oils do.	[r]14	73	United States 64.
Petroleum coke do.	[r]241	488	United States 312; Norway 176.
Bitumen and other residues do.	[r]8	10	All from Finland.
Bituminous mixtures do.	[re]45	[e]27	Finland 26.
Unspecified do.	[r]926	4,892	Romania 1,240; Cuba 115; Poland 88.
Total[2] do.	[r]8,480	6,376	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	[r]123	120	All from Belgium-Luxembourg.

[r]Revised. NA Not available.

[1]For reasons outlined in footnote 1 of table 2 data entered in this table, unless otherwise specified, are compiled wholly or in part from information on trading partner exports to the U.S.S.R. appearing in the sources listed in footnote 1 of that table. As such, the figures presented may represent only a part of total Soviet imports.

[2]Source: Official trade returns of the U.S.S.R.

[3]Subsequent to 1975, official Soviet trade returns do not provide detail regarding total imports or the distribution by trading partners of this metal, but instead provide only an aggregate for total nonferrous metals, broken down into only two categories—unwrought and semimanufactures. Figures presented here represent officially reported Soviet imports for 1975 and the summation of trading partners' reported exports to the U.S.S.R. for 1976. (See footnote 1 of table 2 for detailed list of trading partners included.)

[4]Estimated gross weight, based on reported figure for copper content of exported ore and concentrate.

[5]Partial figure; Japan reports additional exports to the U.S.S.R., but only in terms of value.

[6]Partial figure; some trading partners record additional exports to U.S.S.R., but only in terms of value.

[7]Figures presented here represent the difference between reported Soviet imports of all nonferrous metals (divided only as to the degree of processing) and detail listed above individually under aluminum, copper, lead, tin, tungsten and zinc as indicated by footnote 3. For 1975, this figure should represent metals other than those in the foregoing list together with iron and steel; for 1976, this figure should represent not only these other metals, but also quantities of the metals in the foregoing list that were imported from countries not listed in footnote 1 of the preceding table.

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COMMODITY REVIEW

METALS

Development of the ferrous and nonferrous industries lagged behind goals, as foreseen in the 1976-80 5-year plan; however, production of metals and alloys continued to grow.

Nonferrous ore beneficiation facilities continued to experience poor recoveries of metal, particularly from oxide and mixed ores. Lead concentrates produced from mixed ores at the Zyryanovsk and Leninogorsk complexes in Kazakhstan contained about 60% of the lead present in the ore, and zinc concentrates carried only 30% to 50% of the zinc present in these ores. From 80% to 90% of rare and dispersed elements were discarded in tailings.

Utilization of machinery and equipment continued to be considerably below the planned levels, and modernization and replacement of equipment were slow. As a result, even at advanced enterprises in Kazakhstan's nonferrous industry, productivity was lower than at comparable enterprises in the West. The quality of the drilling rigs and self-propelled equipment lagged.

A number of nonferrous enterprises in Kazakhstan had not fulfilled the plan for exploration, mine development, stripping of overburden, and allowed losses of ores. Therefore, such large enterprises as the Leninogorsk and Irtysh polymetallic complexes did not produce the planned amount of copper, lead, and zinc in concentrates. Owing to unsatisfactory utilization of mining equipment and poor organization of labor and production, the plan for surface mining was not fulfilled by the Sayak and Severo-Dzhezkazgan open pits in Kazakhstan and by the Uchaly complex in the Urals.[59]

As a result of the irregular and uncoordinated work of mines and concentrators, as well as violation of technological processes, many beneficiation plants did not fulfill the plan on extraction and allowed losses of nonferrous metals. Some enterprises do not observe schedules for preventive maintenance and technical servicing of equipment. Leading to accidents and machine idle time.[60]

Many enterprises did not fulfill their goals on raising labor productivity, and at some enterprises of the nonferrous industry, the level of labor productivity was reduced. The Solnechnyy tin complex, the Dzhezkazgan polymetallic complex, and the Donetsk nonferrous metals plant allowed more industrial production personnel than called for by the plan.[61]

Aluminum.—The Soviet Union, second only to the United States in aluminum production, operated 14 primary reduction plants with a total probable annual capacity of 2 million tons by January 1978. Production in 1977 has been estimated at 1.79 million tons, including 150,000 tons of secondary aluminum. The estimated increase in metal output was due mainly to new production from the Krasnayarsk plant in East Siberia. Exports of metal increased from 502,365 tons in 1975 to an estimated 540,000 tons in 1977.

The output of aluminum grew 120% during 1966-75. The 43.3% increase in production of aluminum during the ninth 5-year plan (1971-75) was the highest in the industry's history. During the 1971-75 period, owing to the renovation of the electrolysis unit, output of aluminum increased 10.4% at the Bogoslov aluminum plant. Under the present 5-year plan, output in 1980 is scheduled to be 30% above the 1975 level; the regions east of the Urals are to account for the entire increase. To achieve the planned goals, it is planned to complete construction of the first potline at the Sayansk plant in Siberia. It is also planned to accelerate construction of additional alumina production facilities at the Bogoslovsk and Uralsk aluminum plants in the Urals and at the Kirovabad aluminum plant in Azerbaydzhan. The Nikolayev alumina plant, with an annual capacity of 1 million tons, is to be completed by 1980.

Due to slow construction[62] and delays in the delivery of equipment, construction of the first half of the Regar plant and the first potline at the Sayansk plant will not be completed until 1980. The second stage of the anode plant at the Bratsk aluminum refinery and facilities for the production of alumina from bauxite at the Kirovabad plant have not been completed on schedule. Because of these delays, output of primary and secondary aluminum may not reach 2 million tons by 1980.

In 1977, special attention was given to accelerating construction of the Nikolayev alumina plant and the Sayansk and Regar aluminum plants. The new potline at the

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Krasnoyarsk was completed in March. The country's largest production facility for the calcined anodes was commissioned, with the assistance of Pechiney-Ugine-Kuhlmann, at the end of 1977. After complete renovation, the No. 1 potline at the Bratsk plant was brought up to designed capacity in September. The potline at the Kirov aluminum plant in Volkhov has also reached designed capacity.

Idle times of railroad cars of the Ministry of Railroads exceeded the norms, for which enterprises of the nonferrous industry paid large fines. The cars were unloaded especially poorly at the Krasnoyarsk, Bratsk, and Ural'sk aluminum plants.[63]

The Northern Urals continue to be the main bauxite and alumina producing region. Production of alumina at the Bogoslovsk plant in the Urals increased 22.7% during 1971-75. An additional 70 to 80 million rubles of capital investment is required to obtain capacities for the production of alumina equal to those put into operation at Bogoslovsk during 1971-75. There are five underground and one open pit bauxite mines in operation in the North Urals bauxite region. Production of bauxite in this region increased by 300% during 1945-57 and by 43% during 1967-77.

The second largest bauxite and alumina producing area is Kazakhstan, where the Pavlodar alumina plant No. 1 is among the nation's largest. Plant No. 2 is under construction. Output of alumina at this plant rose 23.7% during 1971-75. The plans call for increases in production of alumina at Pavlodar by 9.4% in 1980 and by 20.4% in 1985 compared with the 1975 level. The plant processes low-quality Turgay bauxite and high-quality imported bauxite. The Severoonezhsk bauxite deposit in Arkhangel Oblast' came onstream in November. Exploration of the Vezhayu-Vor'ekvin (Timan) and Vislovsk (KMA) desposits of bauxite was completed in 1977.

Although the Soviet Union is a large producer of low-grade bauxite, supplies are insufficient, and it is developing alumina production from nepheline and alunite. The alumina is produced from nepheline concentrates only at the Volkhov aluminum plant and at the Pikalevo complex in Leningrad Oblast'. The nepheline is produced at the Apatit complex in the Kola Peninsula and at the Achinsk alumina plant in Siberia. The Razdan alumina-from-nepheline plant in Armenia, which had been under construction since 1968, was to supply alumina to the Sumgait aluminum plant in Azerbaydzhan. Because of the inefficiency in production of alumina from nepheline and pollution of the atmosphere and water, construction of this plant stopped in 1977.[64]

The nepheline-based alumina capacity in Leningrad Oblast' was limited to processing only 1.5 million tons of nepheline concentrate and production of not more than 335,000 tons of alumina from nepheline in 1977. The Achinsk alumina-from-nepheline plant, based on the Kiya-Shaltyrsk deposit, was under construction for a number of years. When it was started up, it proved unprofitable and the rated output indicators have yet not been achieved.[65]

The Kirovabad alumina-from-alunite plant in Azerbaydzhan started production in 1965 but did not reach its planned output. A massive capital investment was allocated to this plant for the 1976-80 period. Facilities for producing alumina from bauxite were to be commissioned in 1976, but the goals were not met. The facilities, which are twice as large as the earlier ones, were commissioned at the end of 1977.

Under a current agreement, Hungary delivered 260,000 tons of alumina to the Soviet Union annually. The agreement envisaged a gradual increase to 330,000 tons of alumina per year in 1980-85. The Zvornik alumina plant in Yugoslavia, the country's largest enterprise processing bauxite into alumina, was being built with Soviet assistance. Its first output, to be produced in 1978, was to be sent to the U.S.S.R. Reportedly, in accordance with the Guinea-Bissau Soviet agreement of February 1977, Soviet geologists continued the examination of the Guinea-Bissau's bauxite deposits. Also, reportedly, Iran was to build a $600 million, 500,000-ton-per-year alumina-from-alunite plant with the aid of Soviet technology and know-how.

The U.S.S.R. operated 15 secondary aluminum units with a total estimated annual capacity of 190,000 tons in 1977. Production was estimated at 150,000 tons of aluminum and its alloys. A second induction furnace for production of secondary aluminum was put into operation at the Sumgait primary aluminum plant in June. Another furnace was to be built by 1980, and the production of secondary aluminum was to increase by 40%. The average selling price of secondary aluminum in the Soviet Union was about 490 rubles per ton in 1977.

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In 1975-77 the Soyuzvtortsvetmet (secondary nonferrous metals) enterprises did not fulfill targets on extraction of secondary aluminum. The greatest losses of metals were being allowed by the Mtsensk and Sukhodol'sk secondary nonferrous metal plants and the Gor'kiy, Tashkent Odessa, and Perm procurement administrations of the Vtortsvetmet.[66]

Antimony.—Deposits of antimony occur at Kadamzhay in Kirgiziya, Dzhidzhikrut in Tadzhikistan, Turgay in Kazakhstan, and Sarylakh and Tazhdolinsk in Siberia. A new antimony production section was commissioned at Kadamzhay, the principal center, in January and production of metal was to be increased by 33%. Renovation of smelting facilities and the development of a new underground level at Kadamzhay mine continued in 1977.

Construction of the new Azhob mine and mill unit (Dzhidzhikrutskiy complex) in Tadzhikistan continued in 1977. During 1966-75, extraction of antimony ore at this complex nearly doubled. An antimony deposit, associated with gold, was under development at Sarylakh in Yakut A.S.S.R. near the Arctic Circle.

Beryllium.—The Soviet Union continued to be one of the world's largest producers and consumers of beryl, beryllium alloys, and metal. Beryllium is found in variable quantities in most of the pegmatites all over the U.S.S.R. There are numerous deposits, mainly in Kazakhstan, Kola Peninsula, Urals, Altay, Transbaykal, Soviet Far East, and Western Ukraine. Domestic reserves are more than adequate. Production was being expanded, and the probable level in 1977 was 1,700 tons of beryl (10% to 12% BeO). It was planned to recover beryllium from the ore of the Dzhidinsk tungsten and molybdenum complex in Buryat A.S.S.R.

Bismuth.—Bismuth is recovered as a byproduct of lead and zinc smelting in Kazakhstan and other areas of the Soviet Union, from dust and crude metal at the Balkhash and Mednogorsk copper complexes, and from tungsten and molybdenum ores. The Ustarasay mine in the Chatkal Mountains is the only enterprise in the U.S.S.R. to mine bismuth ore. The concentrates from this mine are shipped to the Chimkent lead plant for processing.

Cadmium.—Cadmium is produced at various lead and zinc smelters as a byproduct. The Leninogorsk polymetallic complex in Kazakhstan continues to be one of the largest producers. It is planned to obtain a large quantity of cadmium from lead slag.

Chromium.—With an estimated output of 2.18 million tons, the U.S.S.R. was the world's second largest chrome ore producer and exporter in 1977. Over 30% of the production was exported, and about 40% of this was destined to Western countries. While prices for Soviet chromite remained relatively steady, the 1977 shipments were below those of 1976. This was the third successive year that the U.S.S.R. had maintained or increased prices and reduced supply. According to unofficial reports, the f.o.b. prices from the U.S.S.R. rose from $150 to about $155 per ton, 48% Cr_2O_3 basis, with a 4:1 iron ratio. Output of chromite was expected to be 2.3 million tons in 1980. Approximately 40% of the total production was to be exported. During 1950-75, production of chromite ores increased 300%.

Chromite ores are located in Kazakhstan and in the Urals. Measured reserves are estimated at 20 to 25 million tons, and gross reserves add a further 75 million tons. About 94% of the total reserves are in Kazakhstan with the balance in the Urals. The Donskoye mining administration at Khrom-Tau in Aktyubinsk Oblast' of Kazakhstan, which produces over 90% of the Soviet output, is the only supplier of high-quality ore. Deposits of chromium ores in the Urals, which have a low chromium oxide content (20% to 40%) as well as a low Cr_2O_3-Fe ratio, are mostly used in the chemical and refractory industries.

The Donskoye deposits are presently mined selectively at five small open pits. The grade of most ores is adequate for shipping after hand picking. Two mills were in operation at Khrom-Tau during 1977, with a design capacity of 1.5 million tons per year of marketable ore (2.5 million tons of crude).

Output of marketable chromite from the Saranovskoye underground operation in the Urals was estimated at about 10% of the total Soviet production, or about 220,000 tons.

Cobalt.—Gross cobalt reserves are estimated at about 100,000 tons of contained metal, chiefly in nickel-cobalt ores and in cobalt ores of the Khovu-Aksinsk deposit in the Tuva Autonomous Republic. Production continued to be concentrated at Norilsk in Krasnoyarsk Kray; at Monchegorsk and Pechenga on the Kola Peninsula; in the Urals at the Yuzhuralnikel, Ufaley, and

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Rezhsk plants; and also at some copper plants. Cobalt production rose 16% between 1970 and 1975 and was expected to increase by a similar amount during 1976-80.

Copper.—In 1977, the Soviet Union produced an estimated 1,000,000 tons of blister, including 170,000 tons of secondary copper, from 13 smelters with a total probable annual capacity (January 1, 1978) of 1.1 million tons. The secondary blister copper was produced by the Kirovgrad smelter in the Urals, by a Moscow smelting and electrolytic plant, and by several small units of the secondary nonferrous plants. There are 11 refineries in operation.

The country operates 40 concentrators with a total probable annual capacity of about 5 million tons of copper concentrates. Production of concentrates in 1977 has been estimated at about 4 million tons with an average copper content of about 20% (from 12% to 36%).

Sixty-five underground mines and open pits produced an estimated 125 million tons of copper ore in 1977. Approximately 80% of all ore was mined by open pit methods. Up to 10% of primary copper was produced as a byproduct.

Distribution of Soviet smelters and refineries is shown below:

Plant	Location	Type	Began operation
Balkhash	Kazakhstan	Smelter and refinery	1940
Dzhezkazgan	do	do	March 1971
Irtysh-Glubokaya	do	do	Early 1920's-1938
Almalyk	Uzbekistan	do	1965
Kirovgrad	Urals	Smelter (primary and secondary)	1913-May 1922
Kyshtym	do	Refinery	October 1922
Karabash	do	Smelter	May 1925
Krasnoural'sk	do	do	September 1931
Pyshma	do	Refinery	August 1934
Sredneural'sk	do	Smelter	June 1940
Moscow	Moscow	Smelter (secondary) and refinery	1922
Alaverdy	Armenia	Smelter and refinery	1925-46
Severonikel	Kola Peninsula	do	1939
Pechenganikel	do	do	1944
Norilsk	West Siberia	do	1945

Soviet copper consumption by industry is shown, in percentage, in the following tabulation:

	Percent
Production of cables	40.0
Electric engineering industry	14.5
Machine building	12.0
Automobile and tractor construction	8.0
Nonferrous metallurgy	2.0
Consumer goods	3.0
Construction	.3
Other	20.2
Total	100.0

Source: I.M. Gratsershteyn and R.D. Malinova. Ekonomika, organizatsiya i planirovaniye proizvodstva v tsvetnoy metallurgii (Economics, Organization and Planning of Production of Nonferrous Metallurgy). Moscow, 1971.

About 50% of the total consumption of copper is used as pure metal, between 30% and 40% is consumed in alloys, and about 3% is used for chemical products.

Under the new 5-year plan, output in 1980 was scheduled to be 20% to 30% over the 1975 level. If this is achieved, the U.S.S.R. will provide 1.1 million tons of primary and secondary copper by 1980. This might allow more surplus for exports, which increased from 123,000 tons in 1970 to 205,618 tons in 1975. Estimated exports in 1977 were 220,000 tons, with about 300,000 tons projected for 1980. During the 1980-90 decade, the Soviet copper industry will depend for expansion primarily on the Norilsk mining and metallurgical complex and on the Udokan deposit. The completion of the BAM railroad will reduce Udokan development costs and simplify the entire project.

During 1966-75, production of blister increased 50% and output of refined copper rose 41%. In 1977, production of copper ore increased at Sayak (Balkhash complex) and Sary-Cheky (Almalyk complex) and at the Tishinsk, Nikolayev, Orlov, Vostok, and No. 65 underground mines in Kazakhstan; but plan targets were not fulfilled at the Sayak, Severo-Dzhezkazgan, and Uchaly open pits. A shortage of copper concentrates, particularly at the Balkhash complex, resulted in unused smelting capacity.[67]

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To overcome the lag in copper ore production, considerable amounts of money were directed to developing mining operations in 1977. Additional facilities were put into operation at the Dzhezkazgan and Balkhash complexes and at a number of other enterprises in Kazakhstan, the Urals, and the Bashkirian A.S.S.R.

Kazakhstan continued to be the main production center, and the Balkhash complex was the largest copper producer in 1977. A new oxygen electrosmelting furnace was put into operation at the Irtysh complex. Construction of the Zhezkent mine and concentrator and the East Kazakhstan copper-chemical complexes in Kazakhstan continued in 1977; completion of the first stages was scheduled for 1980. It was planned to complete construction of the Karagaylin complex by 1980. Construction of the Boshchekul copper-molybdenum mining and concentration complex and the concentrators at the Dzhezkazgan and East Kazakhstan copper-chemical complexes was started in 1977.

The Urals is the second largest copper-producing region, but the Krasnouralsk, Kirovograd, and Karabash copper smelters in the northern Urals continued to experience a shortage of concentrates. During the past decade, copper grades at all three mines at the Kirovograd complex and at the Degtyar, Gumashev, and Krylatov mines of the Degtyar mine group have decreased. The third section of the Sibay concentrator at the Bashkir copper-sulfur complex was commissioned in December. At the Uchaly complex, in the southern Urals, development of the Molodezhnyy open pit began in November.

During 1973-76, the extraction of copper in concentrate in Armenia increased by 1.32% at Kadzharan, by 3.35% at Agarak, and by 1.02% at Kafan. At the same time, copper content in processed ores decreased by 0.0025% at Kadzharan, by 0.106% at Agarak, and by 0.155% at Kafan. In 1971-77 renovation of the Alaverdy metallurgical complex continued; the technology of electric smelting of calcined copper concentrates was mastered at this complex for the first time in the country. Reverberatory furnaces and converters were converted to natural gas heating. The copper content in copper-molybdenum ores in Armenia ranged from 0.316% to 1.23% and the recovery of copper in copper concentrate from 72.21% to 86.56% in 1977. There are not enough copper ore reserves for the depreciation period of the Kafan and Agarak mining and beneficiation complexes. The Kadzharan and Kafan complexes became parts of the new Zangezur complex in 1977.

In 1976, the Alaverdy complex in Armenia had a shortfall of 3.92% (88.78% instead of the planned 92.7%) in extraction of copper from copper concentrate (16.5% Cu) in blister. Owing to the bulk shipment of different copper concentrates from seven concentrators, hundreds of tons of copper are lost each year. The amount of irrevocable copper losses in dump slags is about 4%, while copper losses in gases and dust are 2.8%.

During 1971-75, capacity of the Almalyk concentrator in Uzbekistan increased 16% and processing of copper ore rose 32.9%. It is planned to achieve the design capacity of the oxygen electrosmelting furnace at Almalyk and construction of a second furnace was to start in 1978. In 1980, processing of copper ore at concentrators was planned to increase 7.5%, and the recovery of copper in concentrates was to improve by 1.6% over the 1975 level. There were 27 shovels in operation at the Kalmakyr open pit of the Almalyk complex in 1977. Exploration of the Sarycheku and Kalmakry deposits at this complex continued. Exploration of the Dal'nyy copper deposit in Uzbekistan began in 1977.

Construction of the Norilsk No. 2 copper and nickel smelters continued in 1977 with Finnish technical assistance. Flash smelting plants for copper and nickel from Outukumpu Oy, Finland, had already been delivered to the Norilsk complex. The annual capacity of the smelters will be 550,000 tons of nickel concentrate (100,000 tons of nickel) and 650,000 tons of copper concentrate (200,000 tons of copper). Completion of the first stages was scheduled for 1980.

Reportedly, agreements were signed between the U.S.S.R. and India on the development of a copper deposit at Malanjkhand. The Soviet Union offered to supply earth-moving equipment to India under a 15-year credit.

Gold.—In 1977, the U.S.S.R. was the world's second largest producer of gold, with an estimated output of 245 tons (7.85 million ounces). The growth in Soviet gold production reportedly resulted mainly from expansion of placer mining in the northeast of the Asian part of the country. Over two-thirds of the total output came from the

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Soviet Far East and East Siberia; most of the balance came from gold and polymetallic ores in the Urals, Kazakhstan, Armenia, and Uzbekistan. Nearly all of the Soviet placer production came from Kolyma, Aldan, Indigarka Yana, Chukotka, and the Urals. The gold mining industry is making wide use of rubber-tired heavy bulldozers (equipped with rippers) and walking draglines to mine deep alluvial deposits. Complex base-metal ores are an important source of gold; according to Soviet sources, over 20% of gold is produced as a byproduct. During the current 5-year plan, production of gold is to be increased in the Soviet Far East, East Siberia, Kazakhstan, Armenia, and Uzbekistan. Gold production is estimated to be 250 tons in 1978 and 260 tons in 1980.

Potential reserves of gold were estimated at about 6,200 tons (200 million ounces) in 1977. Measured reserves were reportedly sufficient for a 12- to 15-year operation at current production rates. Extensive prospecting continued in the Asian part of the country. The discovery of several small vein deposits in Kazakhstan and Uzbekistan was reported in 1977. Several new placer deposits were found at Chukotka and in other regions of the Soviet Far East and Yakutia. However, despite the new discoveries, the rate of incremental growth of ore reserves was lagging behind gold production.[68]

Magadan Oblast' is the main producing center, with 32 placer mines, 23 dredges, over 500 sandwashing rigs, and about 1,500 bulldozers. Three new mines were established in January 1977 by order of the Severovostokzoloto (Northeastern Gold) Association of Magadan Oblast'. They are the Berelekh, with its center at Shirokiy, and the Orotukan and Spornoye mines at settlements of the same name. A new small underground mine was developed at the Korall section of the Bilibino gold mining and concentrating complex in 1977.

The Karamken mining and concentrating complex was the main priority construction project in Magadan Oblast' in 1977, but work was hampered by shortages of equipment. Similarly, development of the Dukat mine in this Oblast' was not satisfactory.

Development of the Muruntau deposit in Uzbekistan, which was discovered in 1960, continued in 1977. The Muruntau open pit (50,000 square meters) was about 100 meters deep in 1977 and the overburden-to-ore ratio was 35:1. The design capacity of both stages of the Muruntau complex is 25 tons of gold per year. Estimated output of gold at this complex in 1977 was 12 tons. Special attention was paid in 1977 to improving technology of gold recovery at the Ararat plant in Armenia, which is fed by ores from the Zod deposit. During 1966-75, recovery of gold at the Sredneuralsk copper complex in the Urals increased 2%.

Iron Ore.—In 1977, 71 underground mines and 63 open pits, with a total capacity of 280 million tons of usable ore, produced 240 million tons of usable ore (direct-shipping ores plus concentrates), an increase of 0.6 million tons over 1976 production. Production of usable ore was scheduled to reach 275.5 million tons (crude ore 560 million tons) in 1980. The following capacity increases were to be accomplished during 1976-80: For usable iron ore, 115.4 million tons; and for sinter and pelletized concentrate, 22.5 million tons.

Annual production capacity of crude ore was increased by 14.1 million tons, compared with a 45-million-ton increase in 1976. The following facilities were commissioned in 1977: The second stage of the Mikhaylov iron ore complex in Kursk Oblast', with a capacity of 3.1 million tons of pellets; the second stage of the Lebedi complex in Belgorod Oblast', with a capacity of 2.15 million tons of pelletized concentrates; the 10th section, with capacity of 0.7 million tons of concentrate, at Kovdor complex in Murmansk Oblast'; and the first stage of the Vostochnyy open pit at Magnitogorsk, with an annual capacity of 1.5 million tons of crude ore.

Shaft sinking for the first stage of the Yakovlevo underground iron ore mine in Belgrad Oblast' began in May 1977. The mine will be 740 meters deep and will have a capacity of 4.5 million tons of crude ore. Development of a new open pit in Kirovgrad Oblast', Ukraine, with an annual capacity of 9 million tons of crude iron ore, began in May.

Ninety-two iron ore concentrators, 29 of which had sintering and 6 of which had pelletizing facilities, produced an estimated 160 million tons of concentrate, 156.7 million tons of sinter, and 36.2 million tons of pellets in 1977. The average iron content was 59.3% in usable ore (including concentrate) and 32.5% in the ore shipped for upgrading.

Exports of iron ore have been substantially maintained at an estimated 43 million

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tons in 1977 against 43.1 million in 1976 and 43.6 million in 1975. The principal importers of Soviet iron ore are Czechoslovakia, Poland, Romania, Hungary, German Democratic Republic, and Bulgaria, which receive about 90% of the total Soviet exports. The U.S.S.R. is meeting 85% of the iron ore requirements of the Comecon countries. In 1966-70, Soviet iron exports to these countries totaled 72 million tons of iron content. Under the 1976-80 plan, exports are scheduled to reach up to 110 million tons of iron content. Details of Soviet total iron ore production and by region, in million tons, is as follows:

	1965	Actual		Estimated 1977
		1970	1976	
Crude ore	237.5	355.1	458.3	470.0
Iron content in crude ore, percent	40.8	37.3	36.1	36.0
Usable ore	152.8	195.5	238.1	240.0
Iron content in usable ore, percent	56.8	58.8	59.3	59.3
Iron content in crude ore concentrated	35.2	32.8	32.6	32.5
Production of iron ore concentrate	80.75	120.8	159.0	160.0
Iron content in concentrate, percent	59.3	61.81	62.4	62.4
Production of pellets	.28	10.6	31.4	36.2
Production of sinter	111.29	138.2	152.7	156.7
Surface mining, percent	71.8	79.2	83.0	83.0

Sources: Gornyy zhurnal (Mining Journal), Moscow, No. 11, November 1977, pp. 6-7; United Nations Economic Commission for Europe, Steel Committee, Steel/WP.1/R.6/Add. 2, Feb. 27, 1978.

Republic and region	1960		1970		1975		1977[e]	
	Million tons	Percent	Million tons	Percent	Million tons	Percent	Million tons	Percent
Total U.S.S.R	105.6	100.0	195.5	100.0	232.8	100.0	240.0	100.0
Including:								
R.S.F.S.R	39.4	37.3	64.8	33.1	86.9	37.3	91.2	38.0
Of this:								
North West	2.2	2.1	7.6	3.9	9.5	4.1	9.6	4.0
Center	4.3	4.1	17.8	9.1	35.8	15.4	39.6	16.5
Urals	26.9	25.4	26.5	13.5	26.1	11.2	26.4	11.0
Siberia	6.0	5.7	12.9	6.6	15.5	6.6	15.6	6.5
Ukraine	59.1	56.0	11.2	56.9	123.3	53.0	126.0	52.5
Kazakhstan	5.8	5.5	18.1	9.3	21.3	9.1	21.6	9.0
Azerbaydzan	1.3	1.2	1.4	.7	1.3	.6	1.2	.5

[e]Estimate.
Source: Gornyy zhurnal (Mining Journal), Moscow, No. 11, November 1977, p. 4.

Iron ore production from open pits of the largest Soviet mining and concentration complexes in 1976 is shown in the following tabulation, in million tons:

Complex	Crude iron ore		Overburden	
	Planned	Actual	Planned	Actual
Olenogor	19.1	14.3	34.9	24.6
Korshunov	15.0	16.1	39.0	35.0
Kachkanar	40.0	36.4	21.4	27.5
Lebedin	30.0	19.1	15.9	21.3
Southern	37.0	32.5	44.0	35.8
New Krivoy Rog	30.0	27.0	55.7	57.6
Northern	48.5	33.7	109.0	60.6
Ingulets	36.4	34.0	20.5	24.9
Central	28.0	21.2	59.1	31.0
Dneprov	34.0	19.8	66.0	33.8
Sokolov-Sarbay	29.5	29.7	125.3	140.1

Source: Gornyy zhurnal (Mining Journal), Moscow, No. 11, November 1977, p. 6.

The Ukraine produced over 52% of Soviet iron ore in 1977, and the Krivoy Rog Basin produced about 90% of the Ukraine's total 1977 output. Some 62% of the country's underground iron production came from 23 Ukrainian mines. The average production cost of iron ore from these mines was 4.22 rubles per ton in 1975. Production cost of surface mined crude iron ore was about 1 ruble per ton.

The Kursk region was the second largest producer, followed by the Urals, Kazakhstan, Siberia, and the Kola Peninsula. Usable iron ore production in the Kursk region increased from 17.8 million tons in 1970 to an estimated 39.6 million tons in 1977. Extraction of 41.2 million tons of iron ore from this region is planned for 1978. Over half of this is to come from the Lebedi

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mining and concentrating complex. The ore from the Kursk region is shipped to metallurgical plants in the Center region, the Urals, and the Ukraine.

Iron ore production in Kazakhstan accounted for 9% of the total, mainly from the Sokolov-Sarbay complex, with an annual capacity of about 30 million tons of crude ore (13.4 million tons of concentrate and pellets).

The U.S.S.R. Ministry of Ferrous Metallurgy, after investing over 250 million rubles in construction of the Lysakov mining and concentration complex in Kazakhstan, suddenly began holding back its development. As a result, the first stage of this complex, with a capacity of 13 million tons of crude iron ore and 6.5 million tons of concentrate per year, was only half attained. The ore contains only 40% iron, and no matter how it is concentrated, good results cannot be obtained. The geologists did not explore the deposit fully.

It is planned to construct a pilot commercial plant for testing the Lisakovsk concentrate, which contains so much phosphorus that pig iron obtained cannot be smelted in an open-hearth furnace. Special facilities are needed, involving time and large capital investment.[69]

Total national minable reserves, divided into categories "A" (measured), "B" (indicated), and "C_1" (inferred), were estimated at 67,300 million tons averaging about 38% iron. Exploration of the Tashtagol, Kholzun, and Belorets iron ore deposits in Siberia continued in 1977.

According to an October 1973 agreement, Finnish companies are building the Kostamush iron ore complex in Soviet Karelia about 30 kilometers from the Finnish border. This project will be built in three stages and will have an annual capacity of 8.9 million tons of pellets (24 million tons of crude ore). Construction of the first stage started in 1977 and will continue till 1982, allowing for the production of about 3 million tons of iron ore pellets per year. Finland will buy up to 1.2 million tons of iron ore pellets per year during 1983-90. The deposit contains an estimated 1,200 to 1,500 million tons of ore with an average iron content of 31%. Construction will take from 8 to 10 years.

Reportedly, the Soviet Union has ordered eight 310-horsepower bulldozers from Poland's Burmar for delivery in 1978. The units will be built in Poland under a licensing agreement with International Harvester Co. These bulldozers will be used to develop iron ore open pits in the U.S.S.R. as part of a Soviet-Polish joint project.

Iron and Steel.—The Soviet iron and steel industry leads the world in total quantity of iron ore mined, coke, refractories, ferroalloys, steel, and steel pipe produced. Each year, the plan for rolled steel is fulfilled, but millions of tons of rolled products are not supplied against orders. Even with large imports of wrought products, there are shortages of many steel products in the U.S.S.R.

In view of the small share of plate-rolled steel in metal production, the share of shaving in machine building is very large. More than 1,000 million rubles are spent annually on the cutting of shavings. According to Soviet published data, the conversion of 1 million tons of rolled ferrous metal products from machinery to precision forging will enable 250,000 tons of metal to be saved and 16,000 metal-cutting machines and more than 20,000 workers to be released. According to TsNIIMPS (Central Scientific-Research Institute of the Ministry of Railways) data, because of inadequate treatment, transport loses about 600,000 tons of steel annually to corrosion. Each year, 150 million rubles are spent to repair and replace structures that have corroded. In the oil industry, 80,000 tons of pipe are lost annually from corrosion.[70]

Of the production facilities put into operation in 1960 and subsequent years, that have been surveyed by the U.S.S.R. Ministry of Ferrous Metallurgy, 49.2% did not attain the planned output, 59.7% did not attain labor productivity, and 85.3% did not meet planned production cost. In the Soviet Union, 23% of workers are working with outdated equipment in pig iron production, 43% in steel smelting, and 42% at rolling operations. Because of poor quality of refractories, their consumption in the Soviet Union is 65.3 kilograms per ton of steel produced, compared with 28.1 kilograms in the United States and 22.1 kilograms in Japan.

Ferrous metallurgy consumes about 18% of the fuel used by the entire industry of the country and about 16% of the electric power. In metallurgy, electric power is used primarily for driving electric machines (65%), in steel and alloy smelting electric furnaces (27%), and for illumination (3%). The use of electric power in the ferrous industry was to increase from 88.1 billion kilowatt-hours in 1975 to 125 billion

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kilowatt-hours in 1980.

In 1977, 36 enterprises, operating 137 blast furnaces, produced 107 million tons of pig iron (planned quota 111.2 million tons), a 2% increase over that of 1976. Estimated outputs for 1978 and 1980 were 110 million and 115 million tons, respectively. The average blast furnace capacity increased from 1,135 cubic meters in 1971 to 1,258 cubic meters in 1977 and was to rise to 1,352 cubic meters by 1980. About two-thirds of all blast furnaces use oxygen for enrichment; over 83% of the pig iron was produced by partial use of natural gas and 75% by use of oxygen.

The construction of the No. 6 blast furnace (3,200 cubic meters, 2.2 million tons per year of pig iron) at Lipetsk continued in 1977. It was planned to invest over 30 million rubles on this project. Completion was scheduled for 1978. Reportedly, construction of blast furnace 5 at Cherepovets plant began in 1977. The furnace is to have a capacity of 5,500 cubic meters, will be 110 meters high and 15.1 meters in diameter, and will produce 4.5 million tons per year of pig iron. Renovation of No. 1 blast furnace at the West Siberian plant in Novokuznetsk and No. 2 blast furnace at Novolipetsk plant was completed in 1977.

The planned capacity of Soviet blast furnaces is shown in the following tabulation:

	Capacity, cubic meters			
	1,033	2,000	3,200	5,000
Annual production of pig iron ___ million tons__	1.1	2.0	3.0	4.6
Number of workers _____	68	92	118	151
Consumption of fuel per ton of pig iron production:				
Coke, dry _ kilograms__	408	395	383	374
Natural gas cubic meters__	149	140	133	127
Oxygen_____do____	171	161	153	146

Source: Shiryayev, P.A., and V.P. Adrianova. Chernaya metallurgiya S.S.S.R. v desyatoy pyatiletke (The Ferrous Metallurgy in the Tenth 5-Year Plan). Moscow, 1977, p. 36.

Production of pig iron by type is shown in the following tabulation:

	1976		1977	
	Million tons	Percent of total	Million tons	Percent of total
Total pig iron production _____	105.3	100.0	107.4	100.0
Of which:				
Steelmaking pig iron _____	96.6	91.7	98.7	91.9
Foundry pig iron _____	7.8	7.4	7.8	7.3
Ferromanganese	.8	.8	.8	.7
Other _____	.1	.1	.1	.1
Production of pig iron using:				
Natural gas___	88.6	84.1	90.5	84.3
Oxygen _____	83.8	79.6	85.5	79.6

Crude steel production from 76 metallurgical works increased 1% to 147 million tons in 1977 (planned quota 151.1 million tons). There were 40 oxygen converters (including 7 with a capacity of 250 to 300 tons) in operation in January 1977. The first stage of the country's largest oxygen converter plant, including two 350-ton converters with an annual capacity of 3.5 million tons, was put into operation at the Azovstal' Zhdanov plant in December. The first stage of the oxygen converter shop (350-ton capacity) was under construction in 1977 at the Cherepovets plant. Construction of a new oxygen converter shop at the Dzerzhinsk works in the Ukraine started in May. Completion of three converters is scheduled for 1980; these will replace a Bessemer furnace and several open hearths. Renovation of converters at the Novolipetsk and West Siberian plants began in 1977. The Soviet steel industry consumed about 83 million tons of ferrous scrap. It was planned to produce 42.5 million tons of oxygen converter steel in 1978.

An open-hearth two-bath furnace, with a capacity of 1.5 million tons of steel per year, was put into operation at the Krivoy Rog Lenin plant in September. It was the fifth "two-bath" furnace in the country and the largest in the Soviet Union. An electric furnace, with an annual capacity of 250,000 tons, was under construction at the Beka-

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bad plant in Uzbekistan. Four additional such furnaces were to be constructed at this plant.

Expansion plans, costing some 2,000 million rubles, were announced for Magnitogorsk. It was planned to construct two blast furnaces, with a capacity of 5,000 cubic meters each, an oxygen converter shop, and new rolling mills. The old rolling mills were to be renovated. At the Novolipetsk works, the main construction projects included blast furnace No. 6 (capacity 3,200 cubic meters) which was under construction and was due to start production in the second half of 1978. On completion of the program, the Novolipetsk works output was to be on the Magnitogorsk level.

The Oskol electrometallurgical complex, which will process ore from the Kursk Magnetic Anomaly, is one of the major construction sites of the 1976-80 plan period. This is the first enterprise in the country designed to produce steel by direct iron reduction. It is being constructed by West German firms. In December 1977, Soviet Metallurgimport awarded to West German Korf Stahl A.G. and Lurgi Chemie and Huettentechnik GmbH a DM500 million contract for four Midrex direct reduction units. A DM185 million order for a pelletizing plant, with an annual capacity of 2.5 million tons, was awarded to Salzgitter A.G. The percentage distribution of steel production was as follows:

Process	1960	1970	1976	1977
Oxygen converter	3.8	15.3	26.0	26.8
Electric steel	8.9	10.7	9.9	9.9
Open hearth	84.4	76.6	63.4	62.7
Bessemer	2.9	1.4	.7	.6
Steel production by continuous casting	NA	NA	7.9	8.3

NA Not available.

Soviet rolled ferrous output in 1977 totaled 118 million tons, of which 102 million tons was finished products (planned quota 105.4 million tons), a 0.7% increase over that of 1976. A rolling mill, with an annual capacity of 1.0 million tons of rolled steel, went onstream at the Nizhniy Tagil complex in November. Another rolling mill was made operational at the Lenin works in Kuznetsk in 1977. Construction of the "3,000" rolling mill at the Lenin plant in Zhdanov started in June. Reportedly, its annual capacity is to be 2.5 million tons of sheet steel for manufacturing oil and gas pipe.

In terms of tonnage, the Soviet Union was the largest world producer of steel pipe, with a total of 17 million tons in 1977, a 1% increase over 1976 production. Construction of facilities for pipe production began at Vyksa metallurgical plant in Gor'kiy Oblast' in May. Pipe developments in the U.S.S.R. included the construction of a new 15,700-ton-per-year pipe mill at the Azerbaydzhan plant and the 320,000-ton-per-year mill at the Severskiy plant in Sverdlovsk Oblast'.

The 11th of the 12 electric-smelting furnaces at Yermak ferroalloys works in Kazakhstan reached its planned capacity in September. The electric furnace, with an annual capacity of 50,000 tons, was completed in 1977. It is planned to construct one more electric furnace of the same capacity at this plant. Construction of the Yermak No. 2 ferroalloys plant began in 1977. It will have four electric-smelting furnaces. Two electric furnaces were under construction at the Nikopol' ferroalloys works in the Ukraine.

The No. 9 oxygen-producing unit, with a capacity of 35,000 cubic meters per hour, became operational at the Krivoy Rog plant. Construction of the No. 10 unit at the same plant began in 1977. The country's only shop for processing steel smelting slag from oxygen converter production was put into operation at the Novolipetsk plant in 1977. Two Soviet-equipped technological lines are to produce more than 2 million tons of construction material per year.

The plan for 1978 provided for the production in the U.S.S.R. of 111.6 million tons of pig iron, 152.4 million tons of crude steel, 106.3 million tons of finished rolled products, and 17.7 million tons of steel pipes. Improved quality and expanded range of products were planned for 1978.

It was planned to produce 15 million tons of steel (an increase of 2.5 million tons) by continuous casting in 1978, principally as a result of the commissioning in 1978 of a new converter shop with continuous casting at the Azovstal' plant.

The main construction targets in the plan for 1978 were the commissioning of a blast furnace and a coke-oven battery at the Novolipetsk and Cherepovets plants; increases in the steelmaking capacity of the converter shops at the Nizhniy-Tagil and Krivorozhstal' plants and the electric furnaces at the Uzbek and Donetsk steelworks; and the commissioning of an "800" universal mill at the Orsk-Khalilovo plant and at

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the new pipe-rolling mills at the Novomoskovsk and Volga pipe works.

Planned production of ferrous metallurgy products in 1980 is detailed in the following tabulation, in million tons:

Commodity	Reported production 1975	Planned production 1980	
		Original plan	New adjusted plan[1]
Iron ore, usable	233	NA	275.5
Pellets	27	62	62
Pig iron	103	NA	121.9
Steel, raw	141	160-170	153.7
Rolled finished ferrous metal	98.6	115-120	114.1
Steel pipe	16.0	NA	18.8

NA Not available.
[1]Koks i khimiya (Coke and Chemistry). Moscow, No. 10, October 1977, pp. 2-4.

In 1975, 83 blast furnaces, 161 open-hearth furnaces, and 35 converters used oxygen and smelted 75.3% of all pig iron, 68% of open-hearth steel, and 96% of converter steel. Expansion of the use of oxygen in ferrous metals production was to continue in 1976-80. It was planned to increase the consumption of natural gas in blast furnaces from 8 billion cubic meters in 1975 to 11.7 billion cubic meters in 1980. The consumption of heavy oil by ferrous metallurgy was to be increased by 96%.

Soviet engineers designed a large metallurgical works for Nigeria. The Soviet Union was to also provide equipment and train local personnel for the plant.

Lead and Zinc.—With estimated output of primary lead at 510,000 tons and zinc at 735,000 tons, the U.S.S.R. was probably the world's second largest producer in 1977. Estimated output of secondary metal was 100,000 tons of lead and 80,000 tons of zinc. Estimated primary production in 1980 was 530,000 tons of lead and 760,000 tons of zinc. Lead exports increased from 92,400 tons in 1970 to an estimated 95,000 tons in 1977, and zinc exports rose from 95,100 tons to 100,000 tons over the same period. The Soviet Union imported an estimated 55,000 tons of lead and 45,000 tons of zinc in 1977.

During 1966-75, output of zinc increased 85.7%. In 1965, 29.5% of the lead and 21.7% of the zinc was produced with the use of oxygen blast, compared with 71% and 63.3% respectively in 1976. Over 10% of the total lead and zinc production was recovered as a byproduct in 1977.

Ore reserves were estimated in 1977 at 16 million tons of contained lead and 20 million tons of contained zinc; over two-thirds are located in Kazakhstan, chiefly in the Altay region and in the district of Kara-Tau. There are also large reserves of zinc in the Urals. Exploration of the Khandizin and Uchkulach lead and zinc deposits in Uzbekistan and Kaudag polymetallic deposit in Azerbaydzhan continued in 1977. Examination of the Filizchay and Kanday lead and zinc deposits was completed in 1977.

Kazakhstan continued to be the leading lead and zinc producer, followed by the Urals, Siberia, Uzbekistan, North Caucasus, Ukraine, and the Soviet Far East. The Ust'-Kamenogorsk lead and zinc complexes in Kazakhstan, one of the leading enterprises in the Soviet lead and zinc industry, increased production of lead 300% during 1950-75. Construction of the Zhayremsk mining and concentration complex continued in 1977. Two open pits at this complex began production, but as the concentrator was still under construction, the ore was shipped to other enterprises in Kazakhstan and even to Georgia.[71] The Zhayremsk deposit of polymetallic ore consists of the Zhayrem, Ushkatyn, Bestobe, and Kuzhal ore bodies. At the Leninogorsk polymetallic and Zyryanovsk lead complexes in this Republic, self-propelled equipment was underutilized in 1977. The Leninogorsk complex did not produce the planned amount of metals in concentrates, and the planned target for ore extraction at the Tishinsk mine of this complex was not obtained in 1977. Work indicators at the Chimkent lead plant were the lowest in the branch.[72]

The first section of the Zhezkent mining and concentration complex and the second section of the Novo-Berezovsk mine in Kazakhstan were put into operation. Ore extraction capacities were enlarged at the Leninogorsk and Irtysh polymetallic complexes and the Zyryanovsk and Tekeli lead and zinc complexes. At the Ust'-Kamenogorsk lead and zinc complex, capacity for production of zinc was enlarged. At the underground mines of many enterprises, including the Leninogorsk, Irtysh, and Almalyk polymetallic complexes and the Zyryanovsk lead complex, self-propelled equipment was underutilized.

In the Urals, the second largest zinc-producing region, slow development of the mines resulted in shortages of ores at the

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concentration plants. During 1966-75, the recovery of zinc from copper-zinc ores at the Urals deposits grew 7.1% and zinc concentrate output increased 150%. During the same period, output of zinc concentrate at the Sredneuralsk mining and metallurgical complex increased 140%.

The second stage of the Sadovyy mine of the Dalpolimetal (Far Eastern Polymetallic) Association in Primorsk Kray was commissioned in 1977. When the mine reaches its full capacity, the Primorsk complex will increase extraction of lead and zinc ores by 50%. Blueprints for the first stage of the Gorevo mining and concentration complex in Irkutsk Oblast' were drawn up in 1977. The lead and zinc deposit lies below the bed of the Angora River.

One of the largest Soviet zinc plants, at Almalyk in Uzbekistan, overfulfilled its 1977 production target. The Sadon lead and zinc mining and concentration complex in North Caucasus operated the Sadon, Zgid, Arkhip, Kholstin, and Fiagdon mines in 1977. The lead and zinc ore of the Kuru-Say deposit in Tadzhikistan is mined at a depth of 650 meters.

Magnesium.—Five magnesium plants, with an estimated combined annual capacity of 73,000 tons, produced 65,000 tons in 1977, 3% more than in 1976. Exports of metal increased from 11,380 tons in 1975 to an estimated 20,000 tons in 1977. Production and consumption of rolled metal in the U.S.S.R. is small.

During 1971-75, production of magnesium and its alloys at the Ust'-Kamenogorsk complex increased 13.8%. In 1976, the output of metal increased by 0.6% over the 1975 level, and it was planned to increase production by 5.3% in 1978. Production of magnesium and its alloys at the Berezniki complex increased 56.3% over the 1966-76 period. During the 1976-80 plan period, capacity for production of magnesium was to be increased.

Manganese.—The Soviet manganese industry remained the largest in the world, with an estimated output of 8.5 million tons of marketable ores (2,940,000 tons of metal content), or 1% less than that of 1976. About three-quarters of the total came from the Nikopol' Basin in the Ukraine, and the rest from the Chiatura Basin in Georgia. Some 300,000 tons of crude ore were produced in Kazakhstan. Exports of manganese ore decreased from 1.5 million tons in 1974 to 1.4 million in 1975 and to 1.3 million tons in 1976.

The principal Soviet manganese basin, the Nikopol' in the Ukraine, has reserves many times greater than the Chiatura, but the ore is little more than 2 meters thick and lies under some 80 meters of overburden. In 1977, 18 underground mines, 10 open pits, and 8 concentration plants were in operation in this basin, with more than 75% of the ore coming from open pit operations. The Nikopol' basin ore averages 26.4% manganese. Concentration by gravity and agglomeration yielded a recovery of 71% to 75% with 45- to 48-percent-manganese concentrates; the balance contained about 34%.

The Chiatura Basin in Georgia, the richest Soviet manganese area, produced about 2.5 million tons of concentrates in 1977 from 23 underground mines and open pits and 8 concentrators. Over 80% was extracted from underground mines. Of the total beneficiated, 66% contained 48.7% Mn, and the rest 25.6% Mn. Development of four small mines continued in 1977. They are to be commissioned during 1978-80.

Mercury.—Output of mercury was estimated at 58,000 flasks (76 pounds each), and the U.S.S.R. was apparently self-sufficient in 1977. There are numerous deposits mainly in Central Asia, the Soviet Far East, and the Ukraine. The Khaydarkan complex in the south of Kirgiziya, the largest Soviet mercury operation, had four mines and a recovery plant in operation in 1977. At this complex, mercury is mined by both underground and open pit methods. Sinking of the 850-meter Tsentralnaya shaft of the Ulug-Too mine at this complex continued in 1977. The renovation of metallurgical facilities at the Khaydarkan complex continued in 1977 and was scheduled for completion in 1980.

The Nikitovskiy complex in the Ukraine, where over 70% of the ore is mined by underground and about 30% by open pit methods, is the second major producer of mercury. Two underground mines (2-bis Novaya and Novo Zavodskaya) and the Polukupol Novvy open pit were in operation at this complex in 1977. The small Zakarpatskiy mercury complex processes ores from the Borkutnoye, Shayanskoye, and other small deposits in Zakarpatskaya Oblast', West Ukraine.

In 1966-75, the extraction of mercury ore in Tadzhikistan nearly doubled. Construction of the new Dzhidzhikrutskiy (Aznob) mercury-antimony complex in this Republic continued but completion of the first stage was rescheduled for 1980 from 1976. The

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Shorbulag, Agyatag, and Levskoye are small mercury deposits mined in Azerbaydzhan. It was planned to start development of new small deposits in Magadan Oblast'. Exploration of the small Tamvatney mercury deposit in the Soviet Far East continued slowly.

Molybdenum.—Output of molybdenum concentrates was estimated at 9,700 tons (metal content), 4% above that of 1976. Reserves of molybdenum in ore (molybdenite, copper-molybdenum, and tungsten-molybdenum ores) in the U.S.S.R. may approach 200,000 tons. About 50% of the production is based on copper-molybdenum ores from Armenia, Kazakhstan, Sorskoye, and Siberia; over 30% is from the tungsten-molybdenum ores of Tyrny-Auz (Kabardin A.S.S.R. in the North Caucasus) and Dzhida (Buryat A.S.S.R.); the remainder arises from molybdenite ore mined in Uzbekistan and Siberia.

Armenia is the largest producer of molybdenum concentrates from copper-molybdenum ores, but the concentrate is shipped out of the Republic for further treatment. The Kadzharan and Kafan copper-molybdenum complexes, which became the part of a new enterprise, the Zangezur complex, in 1977, supplied over 25% of Soviet molybdenum in 1977. However, there are shortages of ore reserves at the Kafan and Agarak mining and beneficiation complexes.[73] In 1976, the extraction of molybdenum at the Kadzharan and Agarak beneficiation plants increased as compared with 1973 by 0.97% and 4.47%, respectively. In the last 4 years, the content of molybdenum in processed ore decreased at the Kadzharan concentrator by 0.0025%. The planned recovery of molybdenum in concentrate (83%) at Kadzharan was attained in 1977.

The Sorskiy molybdenum mining and concentrating complex in Krasnoyarsk Kray was the largest producer in 1977. The Tyrny-Auz tungsten-molybdenum complex, which operates the Molibden underground mine and the Mukulanskiy open pit, was undergoing enlargement in 1977. Output of ore at the Mukulanskiy open pit increased. The Chorukhdayransk concentrator processed copper-molybdenum ores from the Chorukhdayransk and South-Yashransk deposits in Tadzhistan.

Nickel.—With an estimated 142,000 tons of smelter production, 5% more than in 1976, Soviet nickel output was second only to that of Canada. During 1966-75 output of nickel increased 94%, and it was planned to increase metal production by 20% to 30% in 1980 compared with that of 1975. Production is estimated at a probable 150,000 tons in 1978 and 165,000 tons in 1980. Sulfide ores are mined at Norilsk in Krasnoyarsk Kray (East Siberia) and in the Pechenga-Monchegorsk area in the Kola Peninsula. Oxide ores are produced in the Aktyubinsk area of the Southern Urals, the Ufaley area of the Central Urals, and the Ukraine. The centers of production, in order of importance, continue to be Norilsk, the Urals, and the Kola Peninsula. Of the seven smelters in operation, Norilsk is the most important; the Ufaley, Rezh, and Khalilovo smelters in the Urals comprise a close second; the Monchegorsk and Pechenga smelters are third; and the Pobuzhsk ferronickel plant in the Ukraine is fourth. In the future, the Soviet Union will be an important nickel exporter, based on both Soviet and Cuban concentrates.

The Norilsk complex in East Siberia is producing copper, nickel, cobalt, platinum-group metals, selenium, and other rare metals. The recent expansion there has been rapid. During the 10 years prior to 1977, production of ore at Norilsk increased by a factor of 3 and metal output by a factor of 2.5. It was planned to construct the first stages of the No. 2 concentrator and Nadezhda smelter by the end of 1980 and to develop additional mining facilities. The new facilities were to increase capacities for production of nickel by 80%, copper capacity by 70%, and cobalt capacity by 160%.

The fourth stage of the Oktyabr' mine at Norilsk was put into operation in April. A 1,200-meter shaft was sunk at this mine, which has high-grade ore and is one of the largest in the nonferrous industry. It is the deepest in the Polar region and the industry's most highly mechanized. Sinking of a 1,500-meter shaft at the Taymyr mine of the Norilsk complex began in December. It is the third shaft at this mine. It was planned to complete development of the Oktyabr' mine and renovation of the Zapolyarnyy and Komsomol'skiy underground mines by the end of 1980.

The electric furnace at Norilsk, one of the biggest nonferrous units in the country, went into operation after renovation in July. Construction of the Nadezhda copper and nickel plant at Norilsk continued in 1977. The equipment was supplied by a Finnish company. The annual capacity of the nickel plant is to be 550,000 tons of

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nickel concentrate (100,000 tons of nickel). The first stage, originally scheduled for completion in 1974, was initially rescheduled for 1977 and later for 1980. Autoclaves are to be used for the first time.

The ores at the Severonickel complex at Monchegorsk are mined by both open pit and underground methods. The Zhdanovskiy complex is the largest operation in this area. Four small underground mines (Kaula, Kotselvaara, Kammikivi, and Northern) and two small open pits (Kaula and Kammikivi) were in operation at the Pechenganikel complex. The No. 1 truck tunnel at the Northern mine was put into operation in 1977, and the No. 2 tunnel there was being drifted. During 1978-80, it was planned to install new mining and metallurgical facilities at the association "Nikel" (Severonokel and Pechenganikel complexes), to be operated by 3,000 workers. Oxide ore is mined at the Promezhutochnoye, Novo-Burenovskoye, Oktyabr'skoye, and other deposits.

The U.S.S.R. is financing a $600 million expansion of Cuban nickel production, with output of 90,000 tons per year scheduled for 1985. The key elements of the Soviet program to expand nickel production in Cuba by renovation of existing plants and construction of a new plant appear to include expanding production of the Nikaro plant from 18,000 to 22,500 tons per year by 1980, expanding production of nickel at the Moa plant from 18,000 to 24,000 tons per year, and constructing two 30,000-ton-per-year nickel-cobalt oxide plants within 8 kilometers of the Moa plant.

The first new plant (Punta Gorda) is scheduled for completion by 1983-84, and the target date for the second is 1985-86.

Platinum.—The U.S.S.R. remains the largest producer and exporter of platinum-group metals, supplying 20% to 25% of international exports of platinum and more than 50% of world consumption of palladium and rhodium. The U.S.S.R. is steadily expanding its platinum-group metals output with 1977 production estimated at 2.9 million ounces, about 4% over that of 1976. Ore reserves are adequate to maintain current production for many years, with increased exports. The 1976-80 plan calls for platinum-group metals output at Norilsk to rise by about 80% over that of 1975. But slow construction of the Nadezhda plant will limit Soviet primary production increases to an annual rate of 4% to 5%. Production of platinum and platinum-group metals may reach 3.05 million ounces in 1978 and 3.30 million ounces by 1980.

Production of platinum and platinum-group metals comes principally from the Norilsk copper and nickel complex in Krasnoyarsk Kray, the Severonikel and Pechenganikel complexes ("Nikel" association) on the Kola Peninsula, and several small placer deposits in the Urals. Virtually all platinum-group metals were produced as byproducts with about 75% coming from Norilsk. The high priority given to the Norilsk development suggests that the Soviets are determined to proceed with increased production of platinum and platinum-group metals despite high costs imposed by the harsh northern climate. Expansion is expected to accelerate in a few years, with completion of the Oktyabr'skiy underground mine, the No. 2 concentrator, and the first stage of the Nadezhda smelter. The mine had been under development in six stages since 1969 with completion scheduled by 1980. The fourth stage was put into operation in April 1977, and stages five and six were in progress.

In 1977, the U.S.S.R. was in need of foreign exchange to meet the cost of its grain purchases from Western countries. The high level of Soviet indebtedness to the West is an additional reason for a major export drive of platinum-group metals and gold. The U.S.S.R. hoped to sell at least 250,000 ounces of Olympic platinum coins to Western collectors between 1977 and 1980. Reportedly, the United States plans to increase stockpiling of platinum from 453,000 ounces to over 1.3 million ounces. A large proportion of U.S. strategic stockpile will come from the Soviet Union, which will try to increase price in the future. The United States and Japan are the major importers of Soviet platinum-group metals.

Silver.—Output of silver was estimated at 45 million ounces, 2.2% above that of 1976. Almost all silver is produced as byproduct from nonferrous operations, with production mainly centered in the Soviet Far East, Kazakhstan, East Siberia, the Urals, and Armenia. During the year, 14 gold treatment plants extracted silver, as did the Norilsk complex in Krasnoyarsk Kray and some of the Kola copper-nickel enterprises.

The recovery of silver at beneficiation plants in the Urals ranges from 15% to 50% from complex ores containing 6 to 15 grams per ton of silver. The silver content in Soviet lead concentrates fluctuates from 680 to 860 grams per ton. During 1967-1977,

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recovery of silver at the Sredneural'sk copper plant increased 4%. In processing 1 ton of lead-zinc ores, about 200 grams of silver is obtained.

The ash of 1 kilogram of burned Soviet photographic film contains almost 0.2 gram of silver. The Riga secondary precious metals plant increased production of secondary silver in 1977. The silver shop at this plant existed since 1969. During 1970-77, it increased its output of secondary silver several times.

Tin.—Although the Soviet tin production policy is based on self-sufficiency at any price, output continued to be inadequate and about 20% of requirements had to be imported in 1977. Primary tin production in 1977 was estimated at 32,000 tons, 3.2% over that of 1976. The Soviet Far East, Yakutia, and Transbaykal were the main tin producers. The Maritime Kray is the largest producer, and the Khrustal'nyy complex, which operates both lode and placer deposits, is the largest enterprise there. Output of tin may reach 33,000 tons in 1978 and 35,000 tons by 1980. Most new production will come from existing or currently developing mines in the Soviet Far East and Central Asia.

The Khrushtal'nyy complex operated the Khrushtal'nyy, Ege-Khaya, Imeni Lazo, Kholodnyy, and Alyaskavity mines in 1977. The Ternistyy and Arsen'evskaya mines of this complex, which were scheduled for completion in 1975, were still under development in 1977 and have now been rescheduled for completion in 1980. The metal content of the ore is 0.18% to 0.91% at the Arsen'evskaya mine and 0.87% at the Valkumey mine in Magadan Oblast'. The thickness of the veins at the Arsen'evskaya and Valkumey mines in Magadan Oblast' is 0.63 to 0.64 meter.

Development of the Starodubov open pit at the Khinganolovo (Khingan tin) complex at Birobidzhan, Jewish Autonomous Oblast', Khabarovsk Kray was completed in 1977. It has enough reserves for 15 years of operation. Production of ore at Molodezhnyy and Pereval'nyy mines at this complex increased in 1977. The Deputatskiy complex in Yakutia and Sherlovgorskiy in Transbaykal continued to operate in 1977, while the Uchkoshen, Ilintas, Alys-Khaya, Ege-Khaya, and Burgochan deposits were under detailed exploration. Ore grades at Uchkoshen deposit range from 0.80% to 1.32%.

Three known tin refineries operated in the U.S.S.R. in 1977: Novosibirsk (the largest), Ryazan', and Podol'sk (near Moscow). It was planned to increase output of metal at the Sherlova Gora, Ege-Khaya, Leningrad, Sinancha, and other smelters. Output of secondary tin in 1977 was estimated at 12,000 tons, 9% above that of 1976. Construction of a tin-processing unit at the Rustavi secondary nonferrous metals plant in Georgia continued in 1977.

Reportedly, the U.S.S.R. bought about 4,500 tons of Bolivian tin worth more than $50 million for shipment in 1978. The Soviet-built volatilization plant at Palca near Potoci in Bolivia was reportedly running 6 months behind the earlier projected opening of April 1978.

Titanium.—Titanium production in 1977 was estimated at 35,000 tons, 9% over that of 1976. Development of the titanium industry continued to be based mainly on Ukrainian and Siberian ilmenite and rutile. During 1966-76, the output of titanium was increased by 150%. The 1976-80 plan for development of the titanium-magnesium industry emphasized renovation of equipment at the existing plants. Production of titanium was programed to be raised by 40% in the 1976-80 period. Estimated output for 1978 and 1980 was 37,000 and 42,000 tons, respectively.

The output of titanium sponge at the Berezniki complex in the Urals was increased by 150% in 1966-76 and by 75% in 1971-75. During the 1971-75 period, production of titanium sponge at the Ust'Kamenogorsk complex in Kazakhstan increased 41%, and recovery of metal from raw materials increased 4.7%. Output of titanium sponge at this complex was planned to be raised by 7.7% in 1978 over the 1977 level. Soviet reserves of TiO_2 have been estimated at about 10 million tons, contained in 70 million tons of ore averaging 10% to 20% TiO_2.

The most important sources of ilmenite are placer deposits on two right-bank tributaries of the Dnieper River in the Ukraine. Major producers continue to be the Samotkanskoye zirconium-titanium alluvial deposit and the Volchanskoye titanium deposit in Dnepropetrovsk Oblast'; the Irshanskoye, Streminogorskoye, and Zelenogorskoye titanium deposits in Zhitomirskaya Oblast'; and the Tarasovskoye deposit in Kiyevskaya Oblast'.

Two complexes, the Irshanskiy mining and beneficiation complex, where dredges

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are used for ilmenite extraction, and the Verkhnedneprovskiy complex, are the main raw material suppliers for the Soviet titanium industry. Four stages of the Irshansk concentrator were in operation in 1977.

Reportedly, the Soviet Union was planning to build the Armansk No. 2 titanium dioxide plant in the Crimea. The project, with an annual capacity of 100,000 tons, is to be one of the world's largest titanium dioxide plants. The contract value is to be over £100 million. This plant will be the second in Armansk; the first one, with a capacity of 30,000 tons per year, was built by Techmont using technology supplied by its parent company, Montedison.

Tungsten.—Production of tungsten in concentrates was estimated at 8,200 tons, 2.5% more than in 1976, with the North Caucasus, Kazakhstan, Uzbekistan, Transbaykal, and the Soviet Far East continuing as the principal producing centers. Production of tungsten was insufficient to satisfy growing domestic needs, and about one-third of the concentrate requirements were imported. Although most of the deposits in the U.S.S.R. are of low grade, its production is second to China, the world leader. The large deposit in the North Caucasus, the Tyrny-Auz deposit, contains both molybdenum and tungsten. The largest deposits in Kazakhstan are the Verkhne-Kayraktin tungsten and Akchatau molybdenum-tungsten deposits. There are considerable reserves of tungsten at the Ingechke deposit in Uzbekistan and the Jidda deposit in Siberia. Production is estimated at 8,400 tons in 1978 and 8,700 tons in 1980.

The main producer of tungsten concentrates is the Tyrny-Auz tungsten and molybdenum complex in the North Caucasus, where both underground and open pit methods are used. The Iultin complex, the only tungsten mining enterprise in Magadan Oblast', eliminated its shortfall after a long period of underfulfillment of production quotas. The Chorukh-Dayronsk deposit in Tadzhikistan is almost completely depleted and has been replaced by the Yubilennoye deposit, which was put into operation recently. The first stage of the Primorsk complex in Maritime Territory, based on the Vostok-2 tungsten deposit, was commissioned in August. Development of the Yakhtonsk deposit in Uzbekistan and examination of the Maykhurinsk tin and tungsten deposit in Tadzhikistan were completed in 1977. The deposit contains about 1% WO_3.

Reportedly, the tungsten concentrate price continued to rise in 1977. The Comecon countries, and the Soviet Union in particular, were the main purchasers in 1977. The China-U.S.S.R. supply and price relationship has been a significant factor in recent price escalation.

Vanadium.—The Soviet Union, with large vanadium resources, is becoming an important producer and exporter. The principal source in 1977 continued to be vanadium-rich slag, a coproduct with iron from the titaniferous magnetites of the Kachkanar open pits in the Urals. However, the metallurgical problems of vanadium recovery have not yet been satisfactorily resolved. The Nizhniy Tagil metallurgical complex and the Chusovskoy metallurgical plant in the Urals are the enterprises that produce raw material for the production of vanadium and its alloys. Nizhniy Tagil, where the vanadium slag is produced from 130-ton oxygen converters, is the only modern enterprise. The vanadium content of the pig iron at Chusovoy is 0.54%, and that at Nizhniy Tagilii is 0.45%. After devanadization of the pig iron, the average V_2O_5 content of the slag at Chusovoy is 17.2% and that at Nizhniy Tagil is 21.2%.

The enlargement of facilities at the Kachkanar ore mining and concentration complex, from 33 million tons of crude ore to 40 million tons, and the processing of vanadium at the Nizhniy Tagil metallurgical complex have made it possible to increase the output of vanadium products considerably. The special vanadium unit of No. 2 shop at the Ust'Kamengorsk titanium-magnesium complex in Kazakhstan, which was commissioned in 1976, began byproduction of vanadium in 1977.

It is planned to develop the Kachkanar No. 2 and to increase production of vanadium in the future. It is also planned to construct special units at some alumina plants for the recovery of vanadium pentoxide as a byproduct from bauxite and other raw materials.

Minor Metals.—The Soviet Union possesses commercial deposits of all the rare metals that have assumed importance in modern rocketry, aircraft, and nuclear energy. However, extraction of many of them remains low. The main deposits are in Kazakhstan, the Kola Peninsula, Uzbekistan, Armenia, the Urals, the Ukraine,

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Norilsk, Transbaykal, and the Soviet Far East.

As late as 1927, the U.S.S.R. produced only three rare elements: uranium, radium, and selenium. There is evidence that by 1940 there was at least a small-scale production of beryllium, lithium, rare earths and cerium, thorium, uranium and radium, zirconium, cadmium, selenium, tellurium, and strontium. In 1947, the Soviets announced that "in the U.S.S.R. at the present time there is no such chemical element for which there had not been discovered a commercial deposit or a source of practical extraction from a complex mineral raw-material."[74] A great deal of the deposits, no doubt, would have been classified in the United States as submarginal. In the Soviet Union some of these ore bodies might be considered of commercial grade.

The primary sources of rhenium are molybdenite from copper-molybdenum deposits of Armenia, Kazakhstan, and East Siberia. Byproduct rhenium is recovered at the Balkhash and Dzhezkazgan complexes in Kazakhstan, at the Kadzharan copper-molybdenum complex in Armenia, at the hard-alloy plant in Uzbekistan, and at some other plants.

Selenium and tellurium are frequently found together in the base metal sulfide ores. Direct selenium production in the U.S.S.R. started in 1928 from copper-zinc operations in the Urals, and later from lead-zinc deposits in the Altay region and from copper-molybdenum deposits in Armenia, Kazakhstan, and Siberia. Although most of the Ural selenium-bearing deposits contain small quantities of tellurium, production of the latter did not start until much later.

The selenium content in the copper-molybdenum ores of Armenia fluctuates from 3.6 to 10.5 grams per ton and that of tellurium from 1.5 to 6.2 grams per ton. Copper concentrates of Armenia contain 46 to 110 grams per ton selenium and 18 to 62 grams per ton tellurium. There are 110 grams of selenium and 40 grams of tellurium per ton in the charge of the Alaverdy metallurgical complex in Armenia. It is necessary to process 22.5 tons of charge at Alaverdy for recovery of 1 kilogram of selenium and 90.2 tons for recovery of 1 kilogram of tellurium. Extraction of selenium and tellurium at the Alaverdy complex increased in 1977.

According to available Soviet literature, production of indium, germanium, and gallium took place in the U.S.S.R. at the end of 1939 as byproducts from lead-zinc operations in Kazakhstan. Small quantities of germanium have occurred in the ash of some coals and in the tar of some Soviet coking coals. Gallium in concentrations of up to 0.1% was established with muscovite in pegmatite veins of Central Asia. Production of gallium increased at the Chimkent lead plant in Kazakhstan in 1977.

The Soviets claim the world's largest deposits of columbium and tantalum within the limits of the Lovozero massif in the Kola Peninsula. There were two underground mines, the Karnasurt and Umbozero, in operation at Lovozero in 1977. Smaller columbium- and tantalum-bearing deposits are found in the Urals, the Ukraine, the Caucasus, and Transbaykal. The Soviet ilmenite concentrates contain at the average 0.12% Nb_2O_5 and 0.008% Ta_2O_5.

Production of five byproduct minor metals has been started recently at nonferrous metallurgical enterprises in Kazakhstan. Facilities for extracting scandium have been constructed at the Ust'-Kamenogorsk titanium and magnesium complex, and a unit for production of gallium has been put into operation at the Pavlodar alumina plant. A new production shop for recovering minor metals has also been built at the Dzhezkargan metallurgical complex.

NONMETALS

The Soviet Union produces a wide variety of nonmetallic minerals. However, the resource position varies from an adequacy for many nonmetallic minerals to an apparent shortage of others such as barite, fluorspar, mica, and talc.

Asbestos.—The Soviet asbestos industry remains the largest in the world, with an estimated output of the seven grades at 2.46 million tons in 1977. Over 62% of the total production came from the Uralasbest complex, about 28% from Dzhetygara in Kazakhstan, and about 10% from the Tuvaasbest complex in Tuva A.S.S.R. Exports rose from 385,000 tons in 1970 to an estimated 600,000 tons in 1977, with about 60% going to Western markets. In spite of the asbestos export expansion in recent years, the domestic deficit was expected to be about 100,000 tons in 1977.[75] Estimated output for 1978 and 1980 is 2.50 million tons and 2.56 million tons, respectively.

Development in the asbestos industry has been concentrated in the Urals, Kazakhstan, and Tuva A.S.S.R. Three open pits at Uralasbest produced over 37 million tons of crude ore and dumped over 94 million tons

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of overburden in 1977. It is estimated that mining of crude ore and overburden will be increased from 131 million tons in 1977 to about 150 million tons in 1980, but production of marketable asbestos is expected to remain unchanged at about 1.54 million tons because of the decreasing ore grades. The old No. 3 concentrator, with an annual capacity of 120,000 tons of marketable ore, is now obsolete and is to be replaced by a new No. 7 plant.

In Kazakhstan, a large complex has been organized for developing the Dzhetyyara deposit in Kustanay Oblast', which is the second largest in the Soviet Union. The first mill at this complex, with an annual capacity of 200,000 tons, was commissioned in 1965. This mill was renovated in 1971-75, and production increased from 259,000 tons in 1970 to an estimated 360,000 tons in 1977. The Dzhetygara No. 2 mill, with an annual capacity of 400,000 tons, was completed in 1975 and produced an estimated 320,000 tons in 1977. Total output at the Dzhetygara complex will be increased from 680,000 tons in 1977 to an estimated 760,000 tons in 1980.

The first mill of the Tuvaasbest complex, with an annual capacity of 20,000 tons, was put into operation in September 1964. This mill produced over 60,000 tons in 1977. The second mill, with a capacity of 195,000 tons per year, was commissioned in April 1976; estimated production from this mill was 180,000 tons in 1977. It was planned to produce 250,000 tons at Tuvaasbest in 1977. Total output at this complex was to increase from an estimated 240,000 tons in 1977 to planned 265,000 tons in 1980. During 1965-77, the Tuvaasbest complex produced over 500,000 tons of asbestos.

Development of the Kiembay deposit in Orenburg Oblast' (Southern Urals) was started in 1968 and continued in 1977. Seven Comecon members are assisting in the completion of this project, which calls for a total contribution of 106.2 million transferable rubles from the six East European member countries. The total cost of the project is 300 million rubles.

The design capacity of the Kiembay project is 500,000 tons per year of grade III through VI from 24 million tons of ore with an average grade of 4.4%. The complex is to be completed in two equal stages. The first was to be completed in 1979, and its output will be shared among the Comecon members in proportion to their contribution. The Soviet Union will supply asbestos to Comecon countries over a 12-year period starting in 1980. In terms of volume, this represents about half the planned production capacity for each year of the agreement's validity, which can be extended for a further 10 years beyond 1991.

Exploration of the Sayan asbestos deposit on the border of Krasnoyarsk Kray and Tuva A.S.S.R. was completed in 1977, and the reserves are estimated at 7 million tons of asbestos. A mining and beneficiation complex, with an annual capacity of 200,000 tons, is to be built there. The asbestos lies at a comparatively shallow depth and will be mined by opencast methods. When the complex is put into operation it will reduce the U.S.S.R.'s asbestos shortage. By the end of the 1976-80 period, the surveyed reserves of asbestos in the Tuva A.S.S.R. are to increase to 10 million tons.

Barite.—Barite is mined by both open pit and underground methods and, at many operations, crude output is concentrated by flotation. Estimated domestic production in 1977 totaled 450,000 tons, a 12.5% increase over 1976 output. About 60% of the country's barite consumption in 1977 was produced domestically; the balance is filled by imports of high-grade barite, mainly from North Korea, Yugoslavia, and Bulgaria. The main centers of barite output continue to be Georgia, Kazakhstan, and West Siberia. Small deposits have been developed in the Urals, Azerbaydzhan, Armenia, and other regions. Over 30% of Soviet barite reserves are located in Georgia, which produced over two-thirds of the 1977 output. Construction of a 45,000-ton-per-year complex in Khaishi in Svanetia, Georgia, and development of the underground mine at the Zharemsk polymetallic complex in Kazakhstan continued in 1977. The increased output in 1977 was attributed largely to the growth of barite recovery at beneficiation plants of the Achisay, Irtysh, Karagaylin, Tekeli, and Akchataur polymetallic and the Maykan gold complexes in Kazakhstan.

Diamond.—The U.S.S.R. continues to make progress in expanding its diamond industry, which is centered in Yakutia where about 20 deposits have been discovered. In 1977, output was estimated very roughly at 8.2 million carats of industrial quality and some 2.1 million carats of gem quality. Production of diamonds is estimated at a probable 10.5 million carats in 1978, 10.8 million in 1979, and 11 million in 1980. Next to fossil fuels and precious metal exports, diamonds account for the largest share of the Soviet Union's overall foreign

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currency earnings.

Production in the Yakut A.S.S.R. started at a small plant in 1957. In January 1978, the industry consisted of the Mirnyy open pit with five concentrators, the Aykhal open pit and concentrator, the Udachnaya placer mine and concentrator, and the Irelyakh placer mine with two dredges. Small quantities of gem and industrial stones are produced from the Vishera River Region in Perm Oblast' (western Urals), where four dredges and two separation plants were operated at two placer deposits in 1977. Enlargement of the Udachnyy mining and concentration complex is nearing completion. About forty 75-ton Bel AZ 549 dump trucks are in use at the Udachnaya open pit for ore and overburden. This pit is the second mining enterprise (after the Mirnyy open pit) in the country to use these trucks. The town of Udachnyy is being built at the diamond deposit at the edge of the Polar Circle.

Gem stones are being cut at Leningrad, Sverdlovsk, and Smolensk. Sales of cut stones are rising steadily, and substantial increases are expected by 1980. The U.S.S.R. has arranged to market part of its diamond output in Antwerp through a newly formed Soviet-Belgian company in which the Soviet export organization, Almazyuvelirexport, has the controlling interest. The U.S.S.R. State Committee for Science and Technology has signed an agreement with a Belgian company on scientific and technical cooperation in the production and use of diamond tools.

A substantial but unknown quantity of synthetic diamond was also produced in 1977 by plants in Kiyev, Yerevan, Moscow, Tashkent, and Poltava.

Fertilizer Minerals.—Production totaled 23.2 million tons in nutrient content or 96.7 million tons (planned quotas of 98.5 million) in bulk fertilizer content,[76] an increase of 5% over 1976 output. This increase was obtained mainly through the commissioning of new facilities. In 1977, plant capacities were expanded by 4 million tons of fertilizers (Soviet standard) per year, although the planned quota for construction of new facilities was not met. It is estimated that nitrogen fertilizers constitute about 38%; potassium fertilizers, 37%; phosphate fertilizers, 21%; and phosphate flour, 4%.

The breakdown of mineral fertilizer production in nutrient content by commodity is given in the following tabulation, in thousand tons:

Fertilizers	Reported			Estimated
	1970	1975	1976	1977
Nitrogen	5,423	8,535	8,609	8,900
Potassium	4,087	7,944	8,310	8,500
Phosphate	2,500	4,452	4,833	5,000
Phosphatic flour	1,085	1,059	831	800
Unspecified	4	8	7	--
Total	13,099	21,998	22,590	23,200

Source: Narodnoye khozyaystvo S.S.S.R. za 60 let (National Economy of the U.S.S.R., 60 years). Moscow, 1977, p. 213.

There was an increase in exports of mineral fertilizers. Despite substantial production and large exports, fertilizers did not meet domestic demand. A high percentage of superphosphate and potassium fertilizers was not granulated, and great difficulties were experienced in commissioning some new projects and attaining planned capacity of facilities. Reportedly, the 10-year agreement between the U.S. company, Agrico Chemical, and the U.S.S.R. provides that the Soviet Union would supply Agrico with 1 million tons of potash annually in exchange for about 250,000 tons of triple superphosphates.

Soviet exports of mineral fertilizers is shown in the following tabulation, in thousand tons (Soviet standard):

Fertilizers	Reported			Estimated
	1970	1975	1976	1977
Phosphate	518.3	529.9	533.2	535.0
Potassium	5,579.9	5,985.6	5,566.8	5,600.0
Nitrogen	1,520.6	1,311.7	1,693.9	1,700.0
Apatite concentrate	5,994.7	5,830.1	e5,900.0	5,900.0

eEstimate.

Sources: Vneshnyaya Torgovlya S.S.S.R. (Foreign Trade of the U.S.S.R.), Moscow. Statistical Handbooks. 1974, 1975, 1976.

Over 97% of fertilizers were shipped by railroad, mostly in bulk, causing loading losses, moisture penetration, and difficulties in loading and unloading. Unloading takes place at almost 7,000 railroad stations with the use of manual labor. As a result, about 10 million tons of fertilizers are lost each year.[77]

The growth of the Soviet mineral fertilizer industry is one of the priorities of Soviet planners. The 1976-80 plan envisages output of 143 million tons in bulk (32 million tons of nutrients) in 1980, 60% over the 1975 level. During 1976-80, 55.4 million tons per year of new fertilizer capacity is to be

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commissioned. It is planned to invest 12,700 million rubles into construction, renovation, and expansion of fertilizer facilities, or twice as much as in 1971-75. The Apatit and Karatau main phosphate-producing centers will be expanded, and exploitation is to begin at the Chilisay deposit in Aktyubinsk Oblast', Kazakhstan. The 1978 plan called for completion of 15.9 million tons of new fertilizer capacity, compared with 4 million tons in 1977. The U.S.S.R. continued to experience difficulties in completing fertilizer industry projects on schedule because of shortages of material, equipment, and labor, and organizational problems.[78] This will hinder the achievement of the 1980 production target of 143 million tons. Estimated production for 1978 and 1980 is 101 million tons (Soviet standard) and 130 million tons, respectively.

In 1977, new facilities for mineral fertilizer production were commissioned at the Balakovo chemical plant and the Ionava nitrogen fertilizer plant. Construction of a 2,130-kilometer ammonia pipeline has started in the U.S.S.R. with the assistance of United States, French, and West German firms. The pipeline will connect three new ammonia plants now under construction in Togliatti, Gorlovka, and Grigoryev near Odessa with a new port being constructed on the Black Sea coast. The liquefied ammonia will be exported as a part of the Soviet-West fertilizer compensation deal. An agreement for shipment of ammonia to the U.S.A. was signed in 1976 between the U.S.S.R. and the Occidental Petroleum Co.

During 1976-80, equipment for 23 new ammonia plants, each with a capacity of 450,000 tons, was to be supplied by Western companies. All these plants were to be constructed in the U.S.S.R. with the assistance of Toyo engineering (15 plants), Chemico (4 plants), and Creusot-Loire (4 plants). The following seven ammonia plants were scheduled for completion in 1976-77: Berezniki, Chernorechye, Ionova, Kuybyshev, Nevinnomysk, Novokemerovo, and Severodonetsk. The other 16 ammonia plants to be put into operation in 1978-79 were: Cherepovets, Cherkassy, Dorogobush, Dnewprodzerzhinsk, Gorlovka (2 plants), Grodno, Novgorad, Novomoskovsk, Odessa (2 plants), Rossosh, and Togliatti (4 plants).

An agreement between the Soviet Union and the French engineering firm, Speichim, worth F460 million, has been signed for the construction of three 800,000-ton-per-year complex fertilizer plants to be constructed in Novyy Rozdol, Belorechensk, and Meleuz. The plants will produce 17-17-17 NPK material. Reportedly, large tonnages of Soviet ammonia are headed for Western Europe as a result of compensation deals with Creusot-Loire of France, Montedison, Anic, and Mitsui.

Phosphate.—Estimated output of phosphate rock totaled 76 million tons in 1977, including 41 million tons of apatite ore (17% P_2O_5) and 35 million tons of sedimentary rock (13% P_2O_5). The main centers continued to be the Apatit Association on the Kola Peninsula and phosphate deposits at Karatau in Kazakhstan. Deposits of phosphorites also occur in Upper Kama in the Urals, at Egor'evsk and Lopatino in Moscow Oblast', at Kingisepp in Leningrad Oblast', and in some other regions, but the P_2O_5 content is rather low. Generally, they produce phosphorite flour with about 19% P_2O_5.

The phosphate measured, indicated, and inferred reserves in place were estimated in 1977 at 2,717 million tons of phosphorite (overall average grade 13% P_2O_5) and 2,700 million tons of apatite (average grade 17% P_2O_5) in the Khibiny (Kola Peninsula) and 870 million tons (average 4% P_2O_5) at the Oshurkovo deposit in the Transbaykal. Reserves of apatite, totaling 50 million tons, have been confirmed in the Koashva deposit of the Khibiny Mountains.

Because the P_2O_5 content in the ores is declining, a sizable increase in the ore consumption per ton of P_2O_5 is expected. While in 1970, it was 11.7 cubic meters per ton, this indicator should reach 17.2 cubic meters per ton in 1980 and 25.4 cubic meters per ton at new deposits.

Capital construction will play a significant part in the development of the mining and processing facilities in the current plan. A total of 1,120 million rubles will be used, 57% more than in 1971-75. The major part (94%) is allocated for modernization, renovation, and expansion of the existing enterprises in the apatite-phosphorite mining and processing industry; only 67 million rubles (6%) is allocated for construction of new enterprises.

The Khibiny apatite-nepheline deposits are the largest single phosphate source. Mined ore, averaging 16% to 21%, is upgraded to 39.4% P_2O_5 with 92% recovery. The apatite complex produced an estimated 15.5 million tons of concentrate (41 million tons of ore) in 1977 from three open pits and one underground mine and provided about

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70% of all raw materials for the production of phosphate fertilizers. Of the underground and open pit mines, the most important is the Tsentral'nyy open pit, from which over 18 million tons of ore was mined in 1977. U.S. trucks, bulldozers, and other equipment are used. The concentration is carried out in two flotation plants, which in 1977 handled 41 million tons of ore to produce 15.5 million tons of concentrates. The No. 2 plant is larger than the No. 1, but the technology is identical—triple-stage crushing, single-stage grinding and classifying, basic controlling, and three washing-flotation operations (thickening, filtering, and drying).

A new apatite deposit at Mount Koashva was assigned to the Apatit Association in 1973. The Koashva open pit, with an annual capacity of 7 million tons of ore, was under development in 1977. The first stage of this pit, with capacity of 3.6 million tons of ore per year, was scheduled for completion in 1978 and it will be linked to Kirovsk by rail. Construction of the experimental mill at the Zabaykal'sk complex in Buryat A.S.S.R. continued in 1977. Between 1978 and 1980, this mill was to begin experimental production of an apatite concentrate from the Oshurkovo deposit, where reserves are large but have only a 4% P_2O_5 content. In the future, the Zabaykal'sk apatite complex, with an annual capacity of 1.0 to 1.5 million tons of concentrate, is to be built.

At the Kovdor iron ore complex of the Kola Peninsula, an apatite concentrate plant, with a first-stage capacity of 880,000 tons, was commissioned in 1975; the second stage, with the same capacity, was under construction in 1977 and scheduled for completion by 1978. The facility processes tailings from the iron ore concentration complex. The U.S.S.R. Ministry of Chemical Industry, which has already invested over 60 million rubles in the construction of the project, has asked the Gosplan, the central planning body of the Soviet Union, to reduce already reduced planned targets for production of apatite concentrate at Kovdor. Reason for the action is the inability of Soviet fertilizer plants to use apatite from the Kovdor complex owing to the material's excessively high magnesium oxide content.[79]

Apatite production at Kovdor is based on "tailings" from main iron ore beneficiation operations of the complex, and scientists there say that it is impossible to reduce magnesium oxide content to viable levels.[80] The Kovdor complex lost some 7 million rubles in 1976 and showed no sign of recovering the original investment, particularly since operations have sunk to almost experimental levels. However, the second stage of this complex was due to begin producing 880,000 tons per year of apatite concentrate in mid-1978.[81]

The apatite complex was to increase its concentrate output from 15.3 million tons in 1975 to 18.2 million tons in 1980, or by 22%. It was planned to invest 380 million rubles and to commission new facilities for the production of 4 million tons of apatite concentrate, 17 million tons of apatite nepheline ore, and 2 million tons of nepheline concentrate.

The 47 commercial deposits in the Karatau area of Kazakhstan contain 1,500 million tons of minable phosphorite. The five largest deposits, the Dzhantas, Aksau, Chulaktau, Koksu, and Kokdzhone, contain more than half of the total reserves. Seven open pits at the Aksay and Dzhantas deposits and the Molodezhnyy underground mine at the Chulaktau deposit produced an estimated total of over 10 million tons in 1977. Some 70% came from the Dzhantas deposit. The ore content ranges from 21% to 25% and was upgraded to 28.5% P_2O_5, but recovery was low. It was planned to produce about 20 million tons of phosphorite in the Karatau area in 1980. During 1978-80, the following mines were to be commissioned: Kok-Dzhon, annual capacity 4.75 million tons of ore; T'esay, capacity 2 million tons; and Kok-Su, Ur-Bas, Geres, Kis Tas, and other small mines with a total capacity of 20 million tons of ore and 13 million tons of marketable products.

During 1976-80, a mine with an annual capacity of 950,000 tons of phosphorite concentrate, containing 24% P_2O_5, was to be built on the basis of the Chilisay phosphorite deposit in Aktyubinsk Oblast', Kazakhstan. Its commissioning is planned in two stages in 1979 and 1980, each at 475,000 tons per year. A pilot concentrator, with an annual capacity of 10,000 tons of phosphate flour, has been put into operation at Chilisay.

During 1976-80, the Kingisepp phosphorite complex is to invest 270 million rubles to double its production. A double superphosphate plant with an annual capacity of 860,000 tons (18.7% P_2O_5) is to be built here, and its monoammonium phosphate facilities were to be increased from 680,000 to 960,000 tons per year. To meet phosphorite

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flour production plans, the Podmoskovsk mining and chemical complex was to develop new open pits, with a total annual capacity of 3.1 million tons, in 1978-80. At the Lopatino and Yegor'evsk mines, new facilities for production of 200,000 tons per year of phosphorite flour, at a cost of 68.8 million rubles, are to be commissioned by 1980. A 200,000-ton-per-year increase in output of phosphorite flour is expected from the Verkhnekamsk complex in this 5-year plan period. Capacities for the production of 1.44 million tons per year of phosphorite ore, including 840,000 tons per year as a replacement for depleted capacity, are to be commissioned at this complex, at a cost of 27.3 million rubles. During 1976-80, the Bryansk phosphorite plant should commission facilities to produce 750,000 tons per year of phosphorite ore as replacement for depleted ores. Reportedly, the Soviet Union has agreed to buy at least 5 million tons of phosphorite ore from Morocco under a long-term contract.

Potassium.—The Soviet Union is the world's leading producer of potassium salts. Estimated output was 20.0 million tons (41.6% K_2O) or 8.3 million tons in nutrient content, 0.4% higher than in 1976. Output of potash increased from 9.9 million tons (41.6% K_2O) in 1970 to 19.1 million tons in 1975. Under the 1976-80 plan, output of potash was to increase from 19.1 million tons to 26 million tons (41.6% K_2O). Estimated levels of potash output for 1978 and 1980 were 22 million tons and 24 million tons, respectively. The total output of the potassium mines in the U.S.S.R. was about 65 million tons of ore in 1977 and was to be increased to 85 to 90 million tons by 1980. It was planned to construct Soligorsk No. 4, Berezniki No. 4, and Novo-Solikamsk, and to enlarge facilities at the Solikamsk No. 1, Berezniki No. 3, and Soligorsk No. 3 complexes, with a total annual capacity of 8.9 million tons (41.6% K_2O). Soviet exports of potash declined from about 6 million tons in 1975 (41.6% K_2O) to an estimated 5.6 million tons in 1977.

Gross potash reserves are reported at 22,900 million tons of 16% to 40% K_2O content (3,800 million tons of K_2O). About two-thirds of the reserves are located in the Upper Kama Basin in the north Urals. The four major producers are Solikamsk and Berezniki (49.6% of the total) on the western side of the Urals, Soligorsk in Belorussia (43.6%), Stebnikov (2.9%), and Kalush (2.7%) in the West Ukraine. Some 1.2% of the total was produced by enterprises of nonferrous industry. The following 10 complexes, with a total annual capacity of 21.38 million tons (41.6% K_2O), were in operation in 1977: Berezniki Nos. 1, 2, and 3; Solikamsk Nos. 1 and 2; Soligorsk Nos. 1, 2, and 3; and the first stages of the Novostebnikov and Kalush complexes. In the potash mines, the room-and-pillar method is used. In 1977, three complexes were under construction: The first stage of the Soligorsk No. 4 in Belorussia, Berezniki No. 4, and Novosolikamsk in the Urals.

Reportedly, the Soviet Union has signed a DM3 million contract with GHH Sterkrade of the Federal Republic of Germany for the supply of Fahrlanders and spare parts for use in potash mining. In 1975 several Fahrlanders, each with a bucket capacity of 5.6 cubic meters, were sold to the U.S.S.R.

Fluorspar.—Despite the Soviet Union's effort to achieve self-sufficiency, it remained a net importer of fluorspar. Imports of fluorspar, mainly from Mongolia, China, and Thailand, increased from 144,700 tons in 1970 to 493,900 tons in 1975 and to an estimated 500,000 tons in 1977. With an estimated production of 500,000 tons, 2% more than in 1976, Soviet consumption of fluorspar in 1977 was 1 million tons. The iron and steel industry consumed more than 85% of the total, and consumption is increasing by 8,000 to 10,000 tons each year. Estimated levels of fluorspar output for 1978 and 1980 are 510,000 tons and 540,000 tons, respectively.

Soviet consumption of fluorspar in steel production by process is as follows, in kilograms per ton:

Open hearth	0.03 to 1.5
Oxygen converter	2.1 to 5.2
Electric steel	2.5 to 10.2
Ferroalloys	1.07 to 1.42

The Maritime Territory (Yaroslavsk deposit), Transbaykal (Kalaguysk, Abagatuysk, Usuglinsk), Uzbekistan, and Kazakhstan were the main production areas in 1977. The mined ore contained 20% to 45% CaF_2. Hand picking, classification, beneficiation in heavy media, and flotation methods are used for concentration. The Central concentrator in Uzbekistan, which is treating ores containing 24.3% to 26.5% CaF_2, produced a 95% CaF_2 concentrate with recovery of about 85%. The mill in Maritime Territory is treating ores with an average CaF_2 content of 40.5% with about 75% recovery in a 92% CaF_2 concentrate. During 1976-80, it is planned to increase

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recovery and quality of calcium fluoride at the Yaroslavsk, Kalunguysk, and Takobsk (Tadzhikistan) complexes and the Kyakhtinsk mine. Exploration of the Suppatash, Kengutan, and Shabres deposits continued in 1977.

Mica.—Output, estimated at 44,000 tons, 2.3% over that of 1976, was inadequate to meet demand, and strategic-grade mica continued to be imported from India for special industrial requirements. Imports of high-grade mica rose from 483 tons in 1970 to 498 tons in 1975 and to an estimated 550 tons in 1977. Estimated outputs for 1978 and 1980 are 45,000 tons and 47,000 tons, respectively.

Irkuts Oblast' continued to be the main supplier of muscovite mica; 75% of all muscovite deposits in the country are in Mamsko-Chuysk County of Irkutsk Oblast'. Over 1,500 veins have been discovered in this area, and 9 small underground mines were in operation in 1977. Mica is also mined in Murmansk Oblast' on the Kola Peninsula, Karelia, and Yakutia.

The Kovdorslyuda (Kovdor mica) complex in Murmansk Oblast' operates the Yena, Pikolatva, and Kovdor underground mines and vermiculite open pit. Mining of vermiculite began here in 1960, and the first Soviet vermiculite dressing mill was put into operation in 1976. The 38.2% vermiculite content in the ore (average) is upgraded to 88% with recovery of about 64%. The capacity of the Kovdor vermiculite concentrator is 56,000 tons per year of concentrate. The Karelslyuda (Karel mica) complex in Karelia operates the Plotina, Malinovaya Varakka, and Tedino underground mines. Two 400-meter-deep exploratory shafts were being sunk at the Malinovaya Varakka mine in 1977. The Irkuts and Petrozavodsk mica factories are the largest in the U.S.S.R. It is planned to develop the Slyudyanoy Bor deposit in Karelia in the future.

Salt.—The Soviet Union is one of the world's leading countries for salt reserves, production, and exports. Production of salt increased from 12.4 million tons in 1970 to 13.7 million tons in 1975. It was planned to increase production of salt to 20 million tons in 1980; however, the estimated production levels for 1977 and 1980 are 15.5 million tons and 18 million tons, respectively. Exports increased from 293,600 tons in 1970 to 429,767 tons in 1976 and to an estimated 430,000 tons in 1977. Salt development is concentrated in the Donets Basin, the Urals, East Siberia, Armenia, and West Ukraine.

The Donets Basin continued to account for over 40% of the total output in 1977. Development of a new mine, with an annual capacity of 2 million tons, at Artemovsk in this region, construction of the Verkhnekamsk salt complex in Perm Oblast', and renovation of the Iletsk mine in Orenburg Oblast' continued in 1977. The Nizhniy Baskunchak salt complex, with capacity of 700,000 to 900,000 tons per year, was also under construction. Construction of the Mozyr' salt complex in Belorussia, which began in 1974, based on rock salt deposits that lie at a depth of up to 700 meters, continued in 1977. The planned capacity of the complex is 360,000 tons per year. It is planned to develop new mines at rock salt deposits near Gusev in Kaliningrad Oblast', at Belbazh in Gor'kiy Oblast', and near the town of Novaya Zima in Irkutsk Oblast'. The U.S.S.R. has awarded a contract to Tecnimont for the engineering of the 270,000-ton-per-year Sterlitomak salt plant in Bashkiria. The plant, based on Montedison technology, was due to start up in 1977 but was rescheduled for 1978.

Sulfur.—Estimated domestic production of contained sulfur totaled 9.5 million tons, of which 3.3 million tons was recovered from pyrite, 2.1 million tons from native sulfur, and 3.3 million tons from other elemental sulfur. Estimated levels of total sulfur output for 1978 and 1980 were 11.2 million tons and 13 million tons, respectively. Sulfur exports, mainly to Comecon countries, decreased from 463,800 tons in 1970 to an estimated 430,000 tons in 1977. Imports of sulfur increased from 216,700 tons in 1970 to an estimated 650,000 tons in 1977. The principal producers of native sulfur continue to be Rozdol (West Ukraine), Gaurdak in Turkmen S.S.R., Yavorov in West Ukraine, and the Volga group of the Kuybushev sulfur complex, which together produced the bulk of the country's requirements.

The dressing mills of all four complexes are treating ore with a sulfur content from 8% to 40%. Sulfur production by the Frasch process at the Gaurdak complex has increased rapidly since the second installation (100,000 tons per year) went into service in 1975. The No. 3 100,000-ton-per-year installation, using Frasch process at this complex, was nearing completion in 1977. During the 1976-80 period, production of sulfur at Gaurdak is to increase 50% through the commissioning of a new open pit and expansion of production by the Frasch process.

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The Alekseyev and Vodnin mines are in operation at the Kuybyshev sulfur complex. It was planned to recover 895,000 tons of sulfur from the Orenburg sour gas in 1977. During 1976-80, the production of sulfur from gas was to increase by a factor of three.

A sulfur deposit has been discovered in the valley of the River Prut in the vicinity of Ivano-Frankovo. Thirty-three wells have already been drilled to a depth of 250 to 300 meters. Reportedly, the reserves of this deposit are equal to the reserves at the Rozdol deposit in the vincity of L'vov.

Production of sulfuric acid increased from 20 million tons in 1976 to an estimated 22.4 million tons in 1977. Sulfuric acid production began at the Krasnodar chemical complex in North Caucasus, and the third section for production of sulfuric acid at the Dzhezkazgan copper complex in Kazakhstan was completed. In 1977, the nonferrous industry produced 30% of the total country's sulfuric acid output. Poland continues to supply the U.S.S.R. with sulfuric acid plants.

MINERAL FUELS

Estimated production of primary energy derived from fossil fuels, fuelwood, and hydroelectric and nuclear generation increased from 1,696 million tons (standard coal equivalent) in 1976 to 1,779 million tons in 1977. The output of primary energy from all sources in 1980 was to rise to over 2,000 million tons.

Compared with 1975 output, the 1980 production of oil was to rise 30%, natural gas 55%, coal 15%, hydroelectric power 47.9%, and nuclear power 333%. The share of petroleum and natural gas in the total Soviet primary energy production increased from 66.5% in 1976 to 67.3% in 1977, while that of coal (anthracite, bituminous, and lignite) declined from 29.4% in 1976 to 28.5% in 1977. In 1980, the share of petroleum and natural gas in the total energy production is to be 69%, coal will supply about 27%, and 4% will be provided by other sources.

Total estimated consumption of all types of primary energy in the Soviet Union increased from 1,456 million tons in 1976 to 1,529 million tons in 1977. The share of petroleum and natural gas in the total Soviet primary energy consumption increased from 62.5% in 1976 to 63.4% in 1977, while that of coal declined from 32.8% to 31.9%, respectively. Total consumption of all types of primary energy in the U.S.S.R. is expected to be equivalent to about 1,785 million tons of standard coal in 1980. Clearly, there will be a trend towards greater use of oil in the future. However, it is expected that the U.S.S.R. will make great efforts to substitute coal and natural gas for petroleum in order to make the latter available for export.

According to published long-term agreements between the Soviet Union and other nations and the trade objectives announced in the various Comecon countries' 5-year plans (1976-80), it has been estimated that fuel exports from the U.S.S.R. to the market-economy countries would be increased from 94 million tons of standard coal equivalent in 1975 to 145 million tons in 1980. Some 75 million tons of crude oil and petroleum products, 12 million tons of coal and coke, and about 22 billion cubic meters of natural gas is to be exported to market-economy countries in 1980.

Shipments of crude oil and petroleum products to nonmarket-economy countries in 1985 have been estimated at 130 million tons, an increase of 30 million tons over the estimated 1980 level. The amount of crude oil and petroleum products available for export to the West in 1985 will be about 75 to 80 million tons.

In 1977, the U.S.S.R. produced 546 million tons of crude oil and gas condensate, 722 million tons of run-of-mine coal and lignite, and 346 billion cubic meters of natural gas. Soviet long-range forecasting places the demand for raw coal and lignite at over 800 million tons in 1980 and at 1,000 million tons by 2000.

Estimated total primary energy balance of the U.S.S.R. for 1977 and 1980 is shown in table 4.

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Table 4.—U.S.S.R.: Estimated total primary energy balance

(Million tons of standard coal equivalent)

	Production		Imports		Exports		Apparent consumption	
	1977	1980	1977	1980	1977	1980	1977	1980
Total primary energy	1,778.9	2,086.5	38.5	46.7	288.5	347.8	1,528.9	1,785.4
Coal (lignite, anthracite, bituminous, and coke)	507.0	565.0	11.5	13.0	32.0	36.0	486.5	542.0
Crude oil and petroleum products	783.0	915.0	12.0	15.7	220.0	250.0	575.0	680.7
Natural and associated gas	414.0	520.0	15.0	18.0	35.0	60.0	394.0	478.0
Peat	14.4	15.7	--	--	--	--	14.4	15.7
Oil shale	11.5	12.8	--	--	--	--	11.5	12.8
Hydropower	18.0	25.0	--	--	1.5	1.8	16.5	23.2
Nuclear power	5.0	8.0	--	--	--	--	5.0	8.0
Fuelwood	26.0	25.0	--	--	--	--	26.0	25.0

Coal.—In 1977, the Soviet Union produced an estimated 722 million tons of run-of-mine coal—bituminous coal (478 million tons), anthracite (78 million tons), and lignite (165 million tons), or an estimated (according to Western practice) 415 million tons of "clean" coal, placing it second among the world's coal producers. This was 10 million tons of raw coal more than was produced in 1976. Coal production failed to reach its 733-million-ton target by 11 million tons. The 1.5% increase from the 1976 level was achieved mainly in coking coal, 186 million tons of which was produced.

The Soviet coal industry employed 2.2 million men and women, including about 1.2 million "production" workers, some 0.6 million "nonproduction" workers, 213,000 graduate engineers and technicians, and 28,000 managers and general managers. The coal industry employed 770,000 women, including 109,000 at the underground mines. There were 638,000 workers in the Donets coal basin alone in 1975. On the average, there were 60 specialists (mainly mining engineers and geologists) with a university degree and over 150 graduate technicians for each mine. In the U.S.S.R., coal output and productivity are recorded on a ton-for-ton basis of unbeneficiated coal.

New facilities, with an annual capacity of 17.4 million tons of run-of-mine coal and lignite, were commissioned during the year, of which 5 million tons was in the Ekibastuz basin. Construction of new projects continued to be slow, expensive, and frequently below established Western professional standards. At many mines, construction schedules were twice as long as plan specifications. Many new coal mines did not reach their planned capacity in 1977. Some of them have been lagging behind their annual targets for many years. Of 50 new and renovated mines in the Donets coal basin in the past 10 years, 38 had not attained their capacities according to industry reports.

There were about 800 underground mines with an average annual capacity of some 600,000 tons and 70 open pits with an average annual output of 3.4 million tons of run-of-mine coal and lignite. Raw coal production by principal basin in 1977 follows, in million metric tons:

Basin	Total output	Coking coal
Donets	222.0	86.9
Kuznetsk	141.9	60.0
Karaganda	48.2	19.1
Moscow	29.5	--
Pechora	26.7	16.7
Others	253.7	3.7
Total	722.0	186.4

The Donets, Kuznetsk, Karaganda, and Pechora coal basins together produced 80% of the total coal output in terms of calorific value and about 97% of the coking coal in the Soviet Union. The Asian part of the U.S.S.R. (east of the Urals) contributed about 60% of the total production in 1977, compared with 56% in 1975 and 49.5% in 1965.

The average working thickness of the coal seams, according to 1977 data, was 1.32 meters. The maximum depth of underground coal production reached 1,150 meters in 1977, while the average depth was about 400 meters, compared with 380 meters in 1975 and 320 meters in 1965.

The relative share of coal production coming from gently dipping seams was about 70%, that from inclined seams was 14%, and that from steep seams was 16%. The hand-loading of coal at gently inclined seams was about 20% in 1977.

Distribution of coal production by mining methods, in percent, follows:

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Longwall	85
Slicing	8
Shield	3.2
Room-and-pillar	1.7
Others	2.1

In 1977, the average longwall length was 137 meters and the average rate of advance was 40.1 meters per month. The average capacity of each underground mining section (longwall) was 461 tons of raw coal per day (four 6-hour shifts) in 1977.

Coal preparation plants of the Ministry of Coal Industry processed 287.2 million tons of coal in 1977, including 121.9 million tons for coking. They produced 165 million tons of clean coal (recovery 57%), including 84.3 million tons for coking. About 60 million tons of raw coking coal was processed by coal preparation plants of the Ministry of Ferrous Metallurgy. The processing volume increased by 0.9% over that of 1976 and the output of clean coal by 1.5%. The official average ash content of coal shipped to consumers in 1977 was 20.2%. The official records of the Ukrainian Ministry of Coal Industry for 1976 showed that average ash content of coal shipped by the mines was 24%, but actual ash content of shipped coal was 32%, or 8% higher, according to transportation documents.[82]

The biggest consumers of coal are the coal-fired power stations, ferrous metallurgy, industrial and district boiler installations, and the municipal service sector. They account for 74% of the total quantity of coal produced (table 5).

Table 5.—U.S.S.R.: Consumption of coal by sector

(Percent)

Sectors	1965	1970	1975	1977	1980
Coal-fired power stations	35.3	38.1	37.1	38.0	39.7
Industrial and district boiler installations	7.7	7.1	7.2	7.0	6.6
Iron and steel industries	15.4	16.9	13.2	13.0	13.0
Municipal service sector	14.3	17.2	15.9	16.0	14.4
Others	27.3	20.7	26.6	26.0	26.3
Total	100.0	100.0	100.0	100.0	100.0

Table 6 shows the growth of raw hard coal and lignite production in the U.S.S.R.

Table 6.—U.S.S.R.: Growth of raw hard coal and lignite production

(Million tons)

Year	Total coal output	Hard coal (including anthracite)	Anthracite	Brown coal	Use of coal	
					Coking	Others
1965	577.7	427.9	76.5	149.8	138.0	439.7
1970	624.1	476.4	75.8	147.7	164.8	459.3
1975	701.3	537.7	77.0	163.6	181.0	520.3
1976	711.5	548.0	77.7	163.5	186.2	525.3
1977	722.0	556.0	78.0	166.0	186.0	530.0

Although the U.S.S.R. does not publish statistical data on injuries in the coal industry, available Soviet information discloses that "The number of accidents in the coal industry remains high...because untrained people are being sent to the longwalls."[83]

Karagandaugol's coal mining operations, under the town of Karaganda in Kazakhstan, are causing the collapse of houses and other buildings. In addition, over 130 kilometers of the water-supply network have been ruined over the past 5 years, leaving whole areas of the town without water. Karagandaugol' administration is making little or no attempt to prevent the subsidence or restore what it has destroyed.[84]

Total Soviet economically minable coal and lignite reserves in place in categories $A+B+C_1$ (measured+indicated+inferred) in January 1975 were 420 billion tons, including 87 billion tons of coking coal. Over 70% of the total coal and lignite reserves are located in the eastern (Asian) part of the U.S.S.R. Principal coalfields in the European part of the U.S.S.R. are the Donets, the Pechora, and the Moscow basins; the principal fields in the eastern regions are the Kuznetsk and the Karaganda basins.

The Plan for 1980.—The production of raw coal and lignite is planned to rise to 746 million tons in 1978 and to 800 million tons in 1980, but actual output will be below the planned targets. In 1976-80, the annual capacity of coal and lignite mines is to be increased by 123.5 million tons (raw coal and lignite), and 17 coal beneficiation plants, with total annual capacity of 57 million tons of raw coal, are to be constructed or renovated. During the 1976-80

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plan, development of the Ekibastuz, Kansk-Achinsk, and the Southern Yakutsk coal basins will be accelerated. It is planned to increase production of coal and lignite in this period by 28.2 million tons at the Ekibastuz basin, by 24.8 million tons at Kuznetsk, by 14.4 million tons at Kansk-Achinsk, by 11.8 million tons at Donetsk, and by 7.5 million tons at Pechora. The share of surface coal mining is to be about 35% by 1980.

Soviet coal and coke statistics are presented in table 7.

Table 7.—U.S.S.R.: Coal and coke statistics

(Million metric tons)

	Actual					Planned
	1960	1965	1970	1975	1977	1980
Coal:						
Domestic output:						
Run-of-mine coal[1]	509.6	577.7	624.1	701.3	722.0	800.0
Clean coal[2]	306.0	331.0	357.0	400.0	415.0	456.0
Imports: From centrally-planned economy countries[3]	4.7	6.7	7.1	9.8	e9.5	11.0
Exports:						
Centrally-planned economy countries	8.2	15.2	14.8	16.8	e17.5	19.0
Market economy countries	4.1	7.2	9.7	9.3	e10.0	11.0
Total	12.3	22.4	24.5	26.1	e27.5	30.0
Apparent consumption:						
Run-of-mine coal[1]	502.0	562.0	606.7	685.0	704.0	781.0
Clean coal[2]	298.4	315.6	339.6	383.7	397.0	437.0
Coke:						
Domestic output	56.2	67.5	75.4	83.6	e86.0	93.0
Imports: From centrally-planned economy countries[3]	.7	.7	.7	.9	e1.0	1.0
Exports:						
Centrally-planned economy countries	2.2	2.8	3.2	3.2	e3.5	4.0
Market-economy countries	.4	1.0	.9	1.0	e1.0	1.0
Total	2.6	3.8	4.1	4.2	e4.5	5.0
Apparent consumption	54.3	64.4	72.0	80.3	e82.5	89.0

e Estimate.
[1]Run-of-mine coal as reported in Soviet sources.
[2]Clean coal, estimated in accordance with Western practice and experience.
[3]None from market economy countries.

Source: Production data taken from the National Economy of the U.S.S.R., Moscow, 1960, 1965, 1970, and 1975, and Ugol' (Coal), Moscow, No. 4, 1977, p. 67; trade data from Foreign Trade of the U.S.S.R., Moscow, 1960, 1965, 1970, 1975, and 1977.

Natural Gas.—In 1977, the Soviet Union produced 346 billion cubic meters of usable gas, 7.5% more than in 1976 and above the 1977 planned target of 342 billion cubic meters. Of this quantity, over 99% consisted of natural gas and oil associated gases; less than 1% was gas from gasification of coal and oil shale. In 1977, gas accounted for 23.1% of the U.S.S.R. primary energy production and 25.7% of primary energy consumption. Of 5,000 wells operating in more than 650 gas, gas condensate, and gas-oil fields in 1977, 15% to 20% were idle. For the second time since 1956, the gas industry was able to meet its original annual production goal.

The recovery of associated gases rose from 22.9 billion cubic meters in 1970 to 28.6 billion in 1975. Significant losses of associated gases were encountered in many oil producing regions. It was planned to carry out a number of important measures for increasing the effectiveness of utilization of associated gas from 61.6% in 1970 to 85% in 1975. The extraction target for 1975 had been set at 41.5 billion cubic meters in 1970. The actual production of associated gas, however, had reached only 28.6 billion cubic meters in 1975. In 1977, the utilization of associated gas was about 65%. It is planned to extract 43.5 billion cubic meters of associated gas in 1980.

The Ministry of Construction of the Enterprises of the Oil and Gas Industry did not fulfill plans for the development of oil and gas fields and construction of gas pipelines, compressor stations, and underground gas storages according to official reports.

Gasfields.—More than 300 gas and gas-condensate fields were in exploitation in 1977. According to Soviet data, gas reserves in place in the A, B, and C_1 categories as of

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January 1976 were 25,800 billion cubic meters, of which 4,200 billion cubic meters were in the European part of the U.S.S.R., 18,200 billion cubic meters were located in Siberia and the Far East, and 3,400 billion cubic meters were in Central Asia and Kazakhstan.

The Bukharo-Khivinskiy region (eastern Turkmenistan and western Uzbekistan) continued to occupy first place in the production of gas in the U.S.S.R. Production of gas in this region reached an estimated 85 billion cubic meters in 1977, an increase of over 75% compared with the 1971 output. The gross gas reserves as of January 1, 1975, were estimated at 2,761 billion cubic meters (including 1,856 billion cubic meters in eastern Turkmenistan). At the beginning of 1977, 21 gasfields were in operation (including 6 in eastern Turkmenistan) and 15 gasfields were under development (including 4 in eastern Turkmenistan).

Development of the North Achak, Naip, East Shaltyk, and West Shaltyk gasfields in eastern Turkmenistan resulted in the production of about 50 billion cubic meters of natural gas in Turkmen S.S.R. in 1977, four times the amount produced in 1970. The Shaltyk gasfield was supplying 48 to 50 million cubic meters of gas per day in 1977, compared with 40 to 42 million cubic meters per day in 1974. The Uzbek S.S.R. produced an estimated 36 billion cubic meters of gas in 1977. The gasfield at Gazli, the largest in this Republic, produced from more than 200 developmental wells, over three-quarters of the Uzbekistan total.

West Siberian gas production increased from 9 billion cubic meters in 1970 to an estimated 38 billion cubic meters in 1975, 47.8 billion in 1976, and 71 billion in 1977. The region is slated to produce 115 to 145 billion cubic meters in 1980, or 29% to 33% of the Soviet total. Almost two-thirds of total Soviet gross natural gas reserves are located in Tyumen' Oblast'. Four fields were in operation in this region: Punga, Igrim, Pakhomovsk, and Medvezhye. The latter is the largest of the four. The Medvezhye field, development of which began in 1972, produced about 1.5 billion cubic meters in 1972, over 8 billion in 1973, and some 60 billion in 1977, or about 85% of all West Siberian production. This field is expected to produce almost 65 billion cubic meters in 1980.

Drilling of the first developmental well at the Urengoy gasfield in Tyumen' Oblast', the Soviet's biggest gasfield, was completed in June 1975. It is expected that gas production at the Urengoy field will begin in 1978. The Urengoy field is regarded as the world's largest gasfield, with estimated gross reserves of 5,000 billion cubic meters. Output was expected to reach 15 billion cubic meters in 1978, 26.5 billion in 1979, and 58 billion in 1980.

As most of the older producing regions are past their peak, attention is shifting to gasfields in Western Siberia. About 85% of the planned increase in production during 1976-80 was expected to come from this region.

The Ukraine occupied third place in the production of gas in the U.S.S.R. Thirty-four gasfields were in operation, including Shebelinka and Efremovka.

The Orenburg gas condensate field was one of the largest projects of the ninth (1971-75) 5-year plan. Two stages of the Orenburg complex, which is to have a total annual capacity of 30 billion cubic meters of gas, 800,000 tons of sulfur, and 2.4 million tons of condensate, were put into operation in 1974 and 1975. The third (last) stage, with the same capacity of 15 billion cubic meters of gas, was scheduled for completion in 1978. The third stage will consist of 100 operational wells and processing plants. Under a contract signed in September 1975, the French firm Creusot-Loire was to supply the Soviet Union with equipment for the extraction and field processing of 15 billion cubic meters of gas per year of the third stage. Reportedly, the French firm, Technip, and the Soviet Tekhmashimport have signed a F1 billion contract for a natural gas desulfurizing plant, which will be part of the third stage of the Orenburg gas complex. The plant is to have a processing capacity of 17 billion cubic meters of gas per year, the same as that of the first two, which were also constructed by Technip.

Production of gas at the Vuktyl condensate gasfield in Komi A.S.S.R. increased from 18.5 billion cubic meters in 1975 to about 20 billion cubic meters in 1977.

Transportation.—The great distance of the principal consuming centers from the gasfields requires large pipelines for the bulk of natural gas. About 95% of 1977 natural gas production was carried by trunk pipeline, and only 5% was consumed at or near the place of production. The total length of trunk gas pipelines increased from 103,500 kilometers in 1976 to an estimated 110,000 kilometers in 1977. Capital investments in gas transport account for more than 60% of the total investments in the

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gas industry.

Completion of 6,500 kilometers of gas trunk pipelines and 42 compressor stations was planned for 1977. Completed were the 1,300-kilometer Nizhnevartovsk-Tomsk-Kuzbass line, the No. 3 (1,300 kilometers) Ukhta-Torzhok line, and a number of new sectors of the Central Asia-Center and other gaslines. Construction began on the 1,420-millimeter-diameter Komsomol'sk-Surgut-Chelyabinsk gasline.

Consumption.—A preliminary report of Soviet consumption of natural gas in 1977 is presented in the following tabulation:

Consumer	Percent of total
Communal everyday needs	12.8
Generation of electric power	26.2
Industry:	
Chemical	6.5
Metallurgy	15.4
Machine building and metal working	9.9
Construction materials	9.4
Oil and gas	9.2
Light	1.3
Food	3.3
Woodworking	.7
Other	1.4
Total industry	57.2
Transport	.3
Agriculture	.4
Construction	.7
Other consumers and losses	2.4
Total gas consumption	100.0

In the last decade, the structure of natural and associated gas consumption in the Soviet economy has remained comparatively stable. About 12% to 13% of the total amount of gas distributed is used in the public service sector and by households, 55% to 57% is used in various branches of industry, and 24% to 26% is used in thermal powerplants.

In 1977, gas consumption in the chemical industry expanded. Natural gas is used as a feedstock for the production of ammonia and rectified methanol, in the production of phosphate and potash fertilizers, and in other production processes.

In 1977, natural gas was used in the production of 43% of total rolled ferrous metal output, 25% of nonferrous metals, 87% of the steel, 86% of the pig iron, and 61% of the cement.

It was planned to increase consumption of natural gas, in billion cubic meters, as follows:

	1970	1980
Ferrous metallurgy	28.2	48.9
Nonferrous metallurgy	2.6	7.4
Powerplants	51.1	81.3
Agriculture	.7	3.5
Chemical industry	12.9	41.8
Machine building and metal working	18.8	28.8
Construction materials industry	18.3	26.9
Communal everyday needs	25.1	46.4

The Plan for 1978 and 1980.—It was planned to extract 370 billion cubic meters of natural gas in 1978, an increase of 24 billion cubic meters over that of 1977. Most of the increase was expected to come from fields in Western Siberia, Orenburg Oblast', and Central Asia. The extraction of natural gas in 1980 was planned at 435 billion cubic meters—about 146 billion cubic meters over that of 1975. Most of the increase was to come from the following gasfields: Urengoy, Medvezh'ye, Vyngapurovsk, Komsomol'sk (Western Siberia), and Orenburg. In 1976-80, 35,000 kilometers of underground gaslines were to be built. Almost 30% of these consist of 1,420-millimeter-diameter pipe. Compressor stations were to be outfitted with gas-pumping aggregates with a capacity of up to 25,000 kilowatts. The total length of trunk gas pipelines in January 1981 is to be about 134,000 kilometers.

Exports.—Exports of natural gas totaled 1.02 billion rubles, up from 750.6 million in 1976. Value of Soviet gas exports represented 3.1% of total U.S.S.R. official exports, an increase from 2.7% in 1976.

On the basis of value, 55% of Soviets' 1977 gas exports went to East European nonmarketr-conomy countries and 45% to the West European nations of the Federal Republic of Germany, Austria, Italy, France, and Finland.

Combined value of Soviet oil and gas exports represented 31.4% of total U.S.S.R. official exports, an increase from 30.1% in 1976.

Soviet exports of natural gas in 1973-77 are presented in the following tabulation:

Country	Billion cubic meters				Value (thousand rubles)	
	1973	1974	1975	1976	1976	1977
Total	6.8	14.0	19.3	25.8	750,603	1,022,757
Of these:						
Austria	1.6	2.1	1.9	2.8	93,535	106,193
Bulgaria	--	.3	1.2	2.2	74,392	105,578
Czechoslovakia	2.4	3.2	3.7	4.3	147,989	177,859

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Country	Billion cubic meters				Value (thousand rubles)	
	1973	1974	1975	1976	1976	1977
Of these: —Continued						
East Germany	.7	3.0	3.3	3.4	95,409	137,378
Finland	--	.4	.7	.9	41,652	43,135
France	--	--	--	1.0	33,412	67,223
Hungary	--	--	.6	1.0	35,270	39,609
Italy	--	.8	2.3	3.7	52,067	97,384
Poland	1.7	2.1	2.5	2.5	84,207	100,193
West Germany	.4	2.1	3.1	4.0	90,803	145,615

Austria was the first West European country to import Soviet natural gas under a 23-year agreement signed in 1968 and a later agreement signed in 1974. The Soviet Union has three agreements (1970, 1972, and 1974) with the Federal Republic of Germany's Rhurgas for delivery of gas over 20 years in exchange for large-diameter steel pipe and pipeline construction equipment. the Federal Republic of Germany began to receive Soviet gas in 1973.

In 1974, Italy joined the group of West European importers of Soviet natural gas. From 1977, 6 billion cubic meters of Soviet gas will be sent annually to Italy under a 20-year agreement. Deliveries of Soviet gas to Finland under the 20-year agreement started in 1974 and will be raised to 1.4 billion cubic meters per year. France bought Soviet pipeline natural gas for the first time in 1976. Beginning in 1977, 2.5 billion cubic meters of soviet gas was to be sent annually to France under a 20-year agreement.

The Soviet Union intends to increase further deliveries of natural gas to West European countries via a second international piepline of 28-billion-cubic-meter annual capacity to be constructed by 1978. This will also increase deliveries of gas to Czechoslovakia and begin to supply gas to Yugoslavia.

The total length of both stages of the international gasline, including branches, is to be 10,000 kilometers. The main distribution center is Czechoslovakia, whence gas flows through several branch lines to German Democratic Republic, the Federal Republic of Germany, Austria, and Italy. An additional branch line to France is also planned. It is expected that Soviet annual exports of natural gas to Italy, in exchange for additional equipment and plants, will rise from the anticipated 7 billion cubic meters to 10 billion cubic meters per year.

The North Star Siberian gas project for the extraction, liquefaction, and export of natural gas to the United States, Japan, and Western Europe from the Urengoy gasfield was under consideration in 1977. This project was abandoned in 1974 following an unfavorable reception by the U.S. Congress.

Under a new proposal, British, French, and West German banks and financial institutions are to make the loans to the Soviet Union to buy a French liquefied natural gas plant, German pipe, and British auxiliary equipment for the project. The Soviet Union was studying this proposal in 1977. Reportedly, the Soviet Union is investigating the possibility of developing the North Star gas project with financing by the United States, Japan, and West European countries.

Sweden has begun discussions with the Soviet Union on the purchase of Soviet natural gas.

Reportedly, exploratory surveys conducted by U.S. and Japanese firms in Yakutia have confirmed reserves of 700 billion cubic meters. Prospecting for an additional 300 billion cubic meters continued in 1977. Under the present plan, after confirmation of 1,000 billion cubic meters, the Soviet Union would supply gas from the Yakutia fields (after construction of a 4,350-kilometer pipeline) to Japan and the United States at an annual rate of 10 billion cubic meters each for a period of 25 years starting in 1983.

Soviet pipe imports, mostly large-diameter types used for gas and oil lines, were valued at 807.6 million rubles compared with 1,120 million in 1976. The biggest suppliers of pipe were the Federal Republic of Germany, Italy, Japan, Romania, and France.

A group from Mannesmann-Handel AG and Thyssen-Stahlunion AG was granted a contract to supply 380,000 tons of pipes to

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the Soviet Union. The pipes, which were intended for the construction of gas pipelines, were to be suitable for use at low temperatures and were to be manufactured in the first three quarters of 1978. The project was financed on the basis of a credit agreement between a West German banking consortium led by the Deutsche Bank and the Soviet Foreign Trade Bank.

Reportedly, Canada's Export Development Corp. (EDC) will join an international syndicate of lending institutions and finance up to $20.5 million to support the sale, by Cooper-Bessemer of Canada Ltd., of natural gas pumping equipment to the Soviet Union. The sale involves 21 turbine compressers and related components.

The Canadian order is part of a $172 million contract awarded to a consortium of Canadian, British, and Dutch companies for a gas pipeline project in Western Siberia.

Soviet deliveries to Comecon countries in 1977 increased by 40% over those of 1975 and were to be doubled by 1980. The U.S.S.R. planned to substitute natural gas for oil wherever possible in exports to Eastern Europe. Czechoslovakia remained the biggest buyer of Soviet gas in 1977, followed by German Democratic Republic, Bulgaria, Poland, and Hungary.

Under the Soviet-Hungarian agreement of 1971, delivery of natural gas through the first stage of the Soviet-Hungarian Brotherhood Gas Pipeline began on May 1, 1975, and through the second stage in February 1976. Hungary received 0.6 billion cubic meters of Soviet gas in 1975 and 1 billion cubic meters in 1976, and deliveries were to be increased substantially by 1980 to provide gas for both Hungary and Yugoslavia. The annual capacity of the pipeline was 2 billion cubic meters in 1976 and was to be 2.6 billion cubic meters in 1979.

Deliveries of Soviet natural gas through the joint Comecon pipeline from the Orenburg field have been planned for the early 1980's at 15.5 billion cubic meters annually, including 2.8 billion each to Czechoslovakia, Poland, German Democratic Republic, Hungary, and Bulgaria and 1.5 billion to Romania. The 1,420-millimeter-diameter pipeline was to be 2,677 kilometers long and have a capacity of 28 billion cubic meters per year. Over 13,000 East European workers were working in the U.S.S.R. in 1977 on the construction of this line, which was to be completed in the spring of 1979.

According to a Soviet-Bulgarian agreement, the U.S.S.R. was to supply Bulgaria with 3 billion cubic meters of natural gas annually by 1980. Bulgaria was also to receive 2.8 billion cubic meters of gas per year from the Orenburg pipeline. A contract for the supply of 4.5 billion cubic meters of natural gas from the Soviet Union to Czechoslovakia in 1977 was signed in Prague on December 9, 1976.

Soviet gas reserves are on the order of 25 trillion cubic meters, but the development of all these reserves would be extremely difficult and costly. One problem in development at the Tyumen' gasfields is that it takes about 1.5 years to get a piece of heavy equipment in place. Despite the enormous gas reserves, the Soviet Union is not likely to become a major world gas exporter. Siberian gas will, however, become a major factor in domestic energy balance.

Soviet exports will be offset to some extent by imports of gas from Iran and Afghanistan, which decreased from 12.5 billion cubic meters in 1975 to 11.8 billion cubic meters in 1976.

The route of the pipeline from the Soviet-Iranian frontier, which will pump Iranian gas to the Federal Republic of Germany through the U.S.S.R.'s gas transport system, was designed in 1976. The transcontinental pipeline, some 4,000 kilometers long, will carry over 12 billion cubic meters per year. On the basis of long-term loans, West German firms supply the U.S.S.R. with pipe and equipment to speed up development of gasfields. Repayment is made in future deliveries of gas to the Federal Republic of Germany.

Soviet natural gas statistics, in billion cubic meters, are presented in table 8.

Table 8.—U.S.S.R.: Salient natural gas statistics

(Billion cubic meters)

	Actual				Forecast
	1970	1974	1975	1976	1980
Production	197.9	260.6	289.3	321.0	435.0
Exports:					
To West Europe:					
Austria	1.0	2.1	1.9	2.8	3.0
West Germany	--	2.1	3.1	4.0	8.5
Italy	--	.8	2.3	3.7	6.0

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Table 8.—U.S.S.R.: Salient natural gas statistics —Continued

(Billion cubic meters)

	Actual				Forecast
	1970	1974	1975	1976	1980
Exports —Continued					
To West Europe —Continued					
Finland	--	.5	.7	.9	1.4
France	--	--	--	1.0	4.0
Total	1.0	5.5	8.0	12.4	22.9
To East Europe:					
Czechoslovakia	1.3	3.2	3.7	4.3	6.0
Poland	1.0	2.1	2.5	2.5	4.5
East Germany	--	2.9	3.3	3.4	5.0
Hungary	--	--	.6	1.0	3.8
Bulgaria	--	.3	1.2	2.2	5.8
Romania	--	--	--	--	1.5
Yugoslavia	--	--	--	--	1.0
Total	2.3	8.5	11.3	13.4	27.6
Total exports	3.3	14.0	19.3	25.8	50.5
Imports:					
From Iran	1.1	9.0	9.6	8.9	10.0
From Afghanistan	2.5	2.9	2.9	2.9	3.5
Total imports	3.6	11.9	12.5	11.8	13.5
Net exports	.3	2.1	6.8	14.0	37.0
Apparent consumption	198.2	258.5	282.5	307.0	398.0

Sources: National Economy of the U.S.S.R., Moscow, 1970-75; Pravda (Moscow), Jan. 23, 1976; Foreign Trade of the U.S.S.R., Moscow, 1970-76.

Petroleum.—Crude oil and gas condensate output in 1977 increased by 26 million tons (5%) to 546 million tons. The production of crude oil and gas condensate in 1980 is placed at 625 million tons. In 1977, about 500 oil and gas condensate fields (including 36 large fields) were in operation with a total of over 70,000 wells. As of January 1978, the gross reserves of crude oil in place in the U.S.S.R. may total 24 billion tons, including 2 billion tons measured (Soviet category A), 3 billion tons indicated (category B), 5 billion tons inferred (category C_1), and 13 billion tons potential (category C_2). The ratio of measured plus indicated reserves in place to production was 10:1 in 1977. A 30% to 40% recovery of crude oil in place was claimed in 1977. The current reserve-to-production ratio for the country as a whole declined by 45% as compared with that of 1955, and by 20% as compared with that of 1970.

The Soviet Union is rich in oil. However, despite the new discoveries, the rate of incremental growth in oil reserves is lagging behind the rate of growth in crude oil extraction. For the fourth year, the U.S.S.R. remained the world's largest oil producer. The country continued to expand its exports of crude oil and petroleum products even though the quantities available for internal consumption have been inadequate. The Soviet Union became a net exporter of crude oil in 1951 and petroleum products in 1954 and has gradually strengthened its position since that time. Crude exports increased from 0.9 million tons in 1951 to 110.8 million tons in 1976, while exports of products rose from 4.4 million tons in 1954 to 37.7 million tons in 1976. In 1976, exports of crude oil and petroleum products totaled 148.5 million tons, or 14.3% over that of 1975. Of the 1976 total, 64.5 million tons of crude oil and products were shipped to market-economy countries and the rest went to centrally-planned-economy countries, including 77.6 million tons to Comecon nations. The U.S.S.R. exported about 29% of its production in 1976.

Foreign trade of crude oil and products in 1977 accounted for about 9.4 billion rubles, compared with about 7.7 billion in 1976. About 4.2 billion worth of crude and products was delivered to a few non-market-economy countries, mainly Poland, Czechoslovakia, German Democratic Republic, Bulgaria, Hungary, and Cuba. Principal market-economy buyers were Italy, Finland, the Federal Republic of Germany, France, and the United Kingdom.

Reportedly, the U.S.S.R. was selling oil to the member countries of the Comecon at 49.2 rubles per ton. This confirms unofficial information that the price of Soviet oil has been increased by about 23% compared with that of 1976. The Soviet experts justi-

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fied the increase by referring to the constant rise in the world price of oil and to the continual increase in the cost of exploitation and transport from distant areas of Siberia. The mobility of the price scale now used by the Comecon countries will enable the price of Soviet oil gradually to approach the price of oil on the world market, but it is not suggested that this could happen by 1980, as is expected in some Western countries.

Most of the U.S.S.R.'s increased production was derived from the Tyumen' fields, where 206 million tons (24 million tons over that of 1976) were produced in 1977. There were over 140 oilfields in Western Siberia in January 1978. The Samatlor oilfield in Tyumen' Oblast', the largest oilfield in the U.S.S.R., accounted for the major increments in West Siberia. Over 2,000 developmental wells were in operation at this field in 1977. The Fedorov field was the second largest in West Siberia in 1977.

Crude oil extraction (including condensate) is planned to be increased to 575 million tons in 1978, 29 million tons over that of 1977. The 1976-80 plan envisages production of crude oil and gas condensate of 620 to 640 million tons in 1980. The plan calls for the development of about 500 million tons of new capacity during the 1976-80 period; over two-thirds of this is to cover the decline in production of crude at the old fields, and about one-third (151 million tons) is to be available for a net growth in production. The average annual growth in crude oil extraction is to be increased to 30 million tons during the 1976-80. The basic increment in crude oil output is to be secured from the fields in West Siberia. Production of petroleum in this region is planned to increase from 148 million tons in 1975 to 300 to 310 million tons in 1980. In 1976-80, about 30 new oilfields are to be put into operation. The 1980 crude oil and gas condensate output of the U.S.S.R. has been estimated at 625 million tons, on the basis of projections from earlier years.

Based on signed trade agreements and the latest Soviet forecasts, oil exports (crude oil and products) from the U.S.S.R. are expected to increase from 130.4 million tons in 1975, 148.5 million in 1976, and an estimated 155 million in 1977 to 175 million tons in 1980, or 28% of its production that year. Soviet petroleum exports to market-economy countries probably will grow from 52.6 million tons in 1975, 64.5 million in 1976, and an estimated 65 million in 1977, to over 70 million tons in 1980. Crude oil and petroleum product exports from the U.S.S.R. to other centrally-planned economy countries will continue to grow, perhaps attaining 100 million tons per year by 1980.

The 1985 crude oil output of the Soviet Union has been estimated at 750 million tons on the basis of projections from earlier years as modified by information in the long-range plan. Some experts will quarrel with this estimate, but there is ample evidence from an analysis of the producing fields to substantiate these figures. Volga-Urals will continue to decline in relative importance, whereas Tyumen' Oblast' in West Siberia and Kazakhstan will make the most notable gains.

The average rate of growth of crude extraction in the first 7 years of West Siberian oilfield operation was 23 million tons per year. The average growth rate has been 33 million tons per year since then. The Samotlor field accounted for 70% of the total annual production, the Fedorovsk field accounted for 26%, and other fields accounted for the remaining 4%. Every year more than 1,000 wells, with an average depth of 2,000 to 2,500 meters, are drilled in Western Siberia. By 1980, there will be about 40 developed oilfields in operation. In 1977, Tyumen' region produced 206 million tons. By 1980, West Siberia will produce not less than 300 million tons of petroleum.

The anticipated date of peaking of the Samotlor field, the largest in the U.S.S.R., is 1979-86 and that of the Fedorovsk field is 1983-90. There is no reason, therefore, why growth of petroleum production will not continue into the 1980's, and there is no particular problem about meeting the planned targets for petroleum production to 1980 and beyond.

The U.S.S.R. will continue importing a high level of petroleum equipment and technology. With current Soviet technology and partially with equipment from the West, oil output in the U.S.S.R. could peak between 1986 and 1989.

Oil has long been a major export earner for the U.S.S.R., and it is intended to become more important. In recent years, there has been a growing emphasis on Soviet coal and natural gas production, making more petroleum available for export. In terms of value, the exports of petroleum were 24.6% of total Soviet official exports in 1975, 27.4% in 1976, and 28.3% in 1977.

Despite rising Soviet domestic consumption of oil, deliveries to centrally-planned

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economy countries will increase according to obligations entered into, and deliveries to the West will stay at the same level or increase only slightly. The Soviet preference is to sell to the West more refined products, as compared to crude.

Shipments of crude oil to non-market-economy countries in 1985 have been estimated at 110 million tons, an increase of 35 million tons over 1976 shipments and 20 million tons over the estimated 1980 level. About 40 million tons of crude will be available for market-economy countries in 1985.

The amount of petroleum products available for export in 1985 have been estimated at 50 million tons, an increase of 12 million over 1976 exports and 5 million tons over the estimated 1980 level. Soviet exports of products to non-market-economy countries in 1985 have been estimated at 11 million tons. Thus, the amount available for export to the West will be about 39 million tons.

Soviet imports of crude oil and high-quality petroleum products in 1985 will be about 11 million tons. Thus, the net amount of crude oil and petroleum products available for export in 1985 will be about 190 million tons, of which more than 40% will go to the West.

Predictions that the U.S.S.R. will become a net oil importer in the early 1980's appear as unrealistic today as in the late 1960's.

Table 9. - U.S.S.R.: Salient petroleum statistics

Item	Actual					Forecast	
	1960	1965	1970	1975	e1977	1980	1985
Crude oil (including gas condensate):							
Domestic output	147.9	242.9	353.0	491.0	546	625	650
Of which, gas condensate	1.2	2.8	5.0	8.0	9	10	13
Imports	1.2	--	3.5	6.5	6	10	10
Exports:							
To other centrally-planned economy countries	8.8	22.9	39.1	68.5	80	90	110
To market-economy countries	9.0	21.0	24.8	[1]24.6	36	40	40
Total	17.8	43.9	63.9	93.1	116	130	150
Crude product conversion:							
Crude oil to refineries	131.3	199.0	292.6	404.4	436	505	510
Refinery capacity[e]	153.0	225.0	295.0	380.0	410	475	570
Refined oil:							
Output from crude[e]	130.0	169.0	250.0	344.0	372	430	465
Imports	3.2	1.9	1.1	1.1	1	1	1
Exports:							
To other centrally planned economy countries	6.4	6.5	8.0	9.3	10	10	11
To market-economy countries	9.0	14.5	21.0	[1]28.0	29	35	39
Total	15.4	21.0	29.0	37.3	39	45	50
Apparent consumption	117.4	149.9	222.1	307.8	334	386	416

[e]Estimate.

Sources: Production data for 1960, 1965, 1970, and 1975 taken from the National Economy of the U.S.S.R., Moscow 1960, 1965, and 1970; data for 1977 are from Pravda, Moscow, Jan. 28, 1978, p. 1. Trade data from Foreign Trade of the U.S.S.R., Moscow, 1960, 1965, 1970, 1975, and 1977.

Other Fuels and Energy.—Among the Soviet resources of other fuels and energy of lesser significance in the energy economy in 1977 are hydroelectric power, nuclear energy, oil shale, peat, and fuelwood. Peat (fuel), oil shale, and fuelwood together accounted for 7.7% of the total Soviet fuel production in 1960, but by 1977 their aggregate share had fallen to an estimated 4.2%. There was, in fact, an absolute increase in the production of these commodities, a trend which is expected to continue into the future.

Electric Power.—Total electric power generation in 1977 amounted to 1,150 (1,160 planned) billion kilowatt-hours (kwhr), a 3% increase over that of 1977. Electric power generation is planned to rise to 1,207 billion kwhr in 1978 and to 1,380 billion kwhr in 1980.

At the beginning of 1978, the total installed capacity of Soviet electric powerplants reached 238 million kilowatts (kw), of which 45 million kw (or 18.9%) represented hydroelectric capacity and 7.3 million kw

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(or 3%) was nuclear capacity. Most of the future development of electric power capacity will be centered on new thermal powerplants, most of which will be fueled by lignite. There are plans to commission 12 million kw of new electric-power-generating facilities in 1978, comprising 5.9 million kw thermal, 3 million kw nuclear, and 3.1 million kw hydraulic capacity. Under the 1976-80 plan, 71 million kw of new electric-power-generating facilities were to be commissioned and are scheduled to produce 1,380 billion kwhr of electric power annually by 1980. The output of hydroelectric power may reach 197 billion kwhr by 1980. In 1980, the capacity of hydroelectric powerplants may reach approximately 56 million kw. Capital investment in construction of new powerplants for 1976-80 was set at 26 billion rubles, compared with 22 billion rubles under the 1971-75 plan.

Exports of electric power rose from 11.3 billion kwhr in 1975 to 11.5 billion kwhr in 1977 and comprised about 10 billion kwhr to centrally-planned economy countries and over 1.5 billion kwhr to Finland and Norway. Hungary remained the principal importer of Soviet electric power, followed by Bulgaria, Czechoslovakia, and Poland. Under long-term contracts, the U.S.S.R. will export some 15 billion kwhr of electric power annually by 1980, including some 2 billion kwhr to Finland and Norway. Hungary is expected to remain the principal importer of Soviet electric power until 1980. After 1980, the U.S.S.R. will deliver some 4 billion kwhr to Finland annually.

About 85% of all Soviet electrical energy is generated at thermal power stations fueled mainly by lignite as indicated, in percent, in the following tabulation:

Source of fuel	1965	1970	1975	1980
Coal and lignite	60.0	48.6	43.0	45.0
Mazout	11.5	23.0	29.5	28.0
Natural gas	22.1	23.1	22.1	22.0
Peat, oil shale, and other	6.4	5.3	5.4	5.0
Total	100.0	100.0	100.0	100.0

Sources: Elektricheskiye stantsii (Electric Powerplants). Moscow, No. 1, January 1975, p. 3; No. 6, June 1976, p. 5.

Coal and lignite in electric power generation will continue to play a leading role in the foreseeable future, and the share of coal- and lignite-fueled electric power generation is to increase. Up to 75% of the solid fuels burned at the U.S.S.R.'s thermal electric powerplants has a calorific value of 1,500 to 5,500 kilocalories per kilogram (2,650 to 9,850 Btu/lb).

About one-half of the total capacity of hydroelectric power stations of the U.S.S.R. is concentrated at plants with a capacity of over 1 million kw. The largest operating station is the Krasnoyarsk hydroelectric powerplant with a capacity of 6 million kw.

Consumption of power by major branches of the Soviet economy in 1977 and planned for 1978 is shown in the following tabulation:

Consumer	1977		1978 (planned)	
	Billion kwhr	Percent of total	Billion kwhr	Percent of total
Industry and construction	660.9	67.9	685.6	67.2
Transport	86.4	8.9	91.7	9.0
Agriculture and rural population	91.0	9.3	99.5	9.8
Domestic (urban)	135.0	13.9	142.5	14.0
Total	973.3	100.0	1,019.3	100.0

Source: Elektricheskiye stantsii (Electric Powerplants). Moscow, No. 1, January 1978, pp. 2-3.

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Table 10. - U.S.S.R.: Salient power statistics

Powerplants	Actual				Planned				Forecast			
	Capacity Dec. 31, 1977		Production of power in 1977		Capacity Dec. 31, 1978		Production of power in 1978		Capacity Dec. 31, 1980		Production of power in 1980	
	Million kw	Percent	Billion kwhr	Percent	Million kw	Percent	Billion kwhr	Percent	Million kw	Percent	Billion kwhr	Percent
Thermal	185.8	78.0	971	84.3	192.8	77.1	1,000.7	82.9	214.0	75.6	1,133	82.2
Hydroelectric	45.2	19.0	145	12.7	47.2	18.8	165.0	13.7	54.0	19.1	197	14.2
Nuclear	7.3	3.0	34	3	10.3	4.1	41.3	3.4	15.0	5.3	50	3.6
Total	238.3	100.0	1,150	100.0	250.3	100.0	1,207.0	100.0	283.0	100.0	1,380	100.0

Sources: Elektricheskiye stantsii (Electric Powerplants). Moscow, No. 1, January 1978, pp. 2-3; National Economy of the U.S.S.R. in 1977, Moscow, 1977, p. 201.

Hydroelectric Power.—The economic technical potential of hydroelectric power in the U.S.S.R. was placed at 1,095 billion kwhr per year. In the overall energy economy of the Soviet Union, however, water power is of relatively small significance. Hydroelectric power supplied 145 billion kwhr, or 12.7% of all electric power generated in 1977.

Nuclear Power.—The Soviet Union operated 10 atomic powerplants, with a total capacity of 6,317 megawatts, or about 2.8% of the capacity of all electric powerplants in the country on January 1, 1977, as follows: Novo-Voronezh, four reactors, total capacity 1,455 megawatts; Beloyarsk, two reactors, 300 megawatts; Melekess, one reactor, 72 megawatts; Kola Peninsula, two reactors, 880 megawatts; Shevchenko, one reactor, 150 megawatts; Bilibino, four reactors, 48 megawatts; Obninsk, one reactor, 5 megawatts; Armenia, one reactor, 407 megawatts; Kursk, one reactor, 1,000 megawatts; and Leningrad two reactors, 2,000 megawatts. The first stage (one reactor) at Chernobyl, with a capacity of 1,000 megawatts, was put into operation in September 1977. Therefore, the total installed capacity of all 11 Soviet nuclear powerplants on January 1, 1978, was 7,317 megawatts, or 3% of the total capacity of all electric powerplants in the U.S.S.R.

In 1977, Soviet nuclear powerplants generated over 34 billion kwhr (26 billion more than in 1976), or 3% of all power supplied in 1977. Several nuclear powerplants were under construction in 1977, some of which were scheduled for completion by 1980. Plans are to install 13,750 megawatts of new nuclear capacity by 1980 and to generate 80 billion kwhr of nuclear electricity in 1980. Estimated level of Soviet nuclear generating capacity for 1980 is 15,000 to 17,000 megawatts. The U.S.S.R. will probably increase the production of nuclear power from 34 billion kwhr in 1977 to 50 billion in 1980. Nuclear power output is to represent about 3.6% of national electric power production and 0.3% of total Soviet primary energy output by 1980.

Soviet nuclear energy statistics are presented, in megawatts, in the following tabulation:

Nuclear plant and unit	Began operation	Capacity (megawatts)	
		Actual Jan. 1, 1978	Estimated Dec. 31, 1980
Obninsk	1954	5	--
Beloyarsk No. 1	1964	100	--
Beloyarsk No. 2	1967	200	--
Beloyarsk No. 3	--	--	600
Novo-Voronezh No. 1	1964	210	--
Novo-Voronezh No. 2	1969	365	--
Novo-Voronezh No. 3	1971	440	--
Novo-Voronezh No. 4	1972	440	--
Novo-Voronezh No. 5	--	--	1,000
Melekess	1965	72	--
Shevchenko No. 1[1]	1973	150	--

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Nuclear plant and unit	Began operation	Capacity (megawatts) Actual Jan. 1, 1978	Capacity (megawatts) Estimated Dec. 31, 1980
Bilibino No. 1	1973	12	--
Bilibino No. 2	1975	12	--
Bilibino No. 3	1975	12	--
Bilibino No. 4	1976	12	--
Kola Peninsula No. 1	1973	440	--
Kola Peninsula No. 2	1974	440	--
Kola Peninsula No. 3	--	--	440
Armenia No. 1	1976	407	--
Armenia No. 2	--	--	440
Leningrad No. 1	1973	1,000	--
Leningrad No. 2	1975	1,000	--
Leningrad No. 3	--	--	1,000
Leningrad No. 4	--	--	--
Kursk No. 1	1976	1,000	--
Kursk No. 2	--	--	1,000
Kursk No. 3	--	--	1,000
Kursk No. 4	--	--	--
Smolensk No. 1	--	--	1,000
Chernobyl No. 1	--	1,000	--
Rovny No. 1	--	--	440
South Ukrainian No. 1	--	--	1,000
New capacity	--	1,000	7,920
Total capacity	--	7,317	15,237

[1]The first dual-purpose nuclear powerplant (350,000 kilowatts) using a sodium-cooled fast reactor with a designed capacity of 150,000 kilowatts and desalination capacity of 120,000 cubic meters per day of fresh water.

Source: Elektricheskiye stantsii (Electric Powerplants). Moscow, No. 11, November 1977, p. 15.

The U.S.S.R. provides technical assistance in the construction of nuclear powerplants in Comecon countries. The East European countries operated four nuclear powerplants (six reactors) with a total capacity of 1,970 megawatts on January 1, 1978. German Democratic Republic takes first place among the area's nuclear power producers, followed by Bulgaria and Czechoslovakia. The aggregate capacity of nuclear powerplants operating in the Comecon countries was 9,287 megawatts on January 1, 1978.

East European nuclear energy statistics are presented, in megawatts, in the following tabulation:

Country, nuclear plant, and unit	Began operation	Capacity Jan. 1, 1978
East Germany:		
Rheinsberg	1966	70
Greifswald No. 1	1973	440
Greifswald No. 2	1974	440
Total	--	950
Bulgaria:		
Kozloduy No. 1	1974	440
Kozloduy No. 2	1976	440
Total	--	880
Czechoslovakia: Yaslovske Bohunice	1972	140
Grand total	--	1,970

Construction of nuclear powerplants, with a capacity of 440 megawatts each, continued in Hungary (Paks nuclear powerplant) and Romania in 1977 and scheduled for completion by 1985.

The first nuclear powerplant in Poland, with a capacity of 440 megawatts, is to be built on Lake Zarnowieckie, Gdansk Province, during the 1990's. Cuba's first atomic power station is to be built in Las Villas Province with Soviet assistance. The U.S.S.R. is to supply equipment for the plant, and the generating capacity of its first stage is to be 440 megawatts.

The first stage of the Loviisa nuclear powerplant in Finland, with a capacity of 440 megawatts, was under construction with Soviet assistance in 1977. Under a Finnish-Soviet agreement, the main machinery, reactor units, turbines, and nuclear fuel will be delivered by the Soviet foreign trade organization Atomenergoexport.

Oil Shale.—Shale plays only a minor role in total Soviet energy economy, accounting for 0.65% of production and 0.71% of consumption in 1977. The production of oil shale increased from 35.1 million tons in 1976 to an estimated 35.5 million tons in 1977. The output of oil shale may possibly reach 36 million tons in 1978 and 38 million tons in 1980. Seventy-four percent of the extracted shale in the U.S.S.R. is burned at

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the thermal powerplants, about 21% is processed into furnace oil, gasoline, fuel gas, phenols, and aromatic hydrocarbons, and over 5% of the total is used in commercial everyday needs. The world's biggest powerplant in Tallin, fueled by shale, has reached a capacity of 1,600,000 kilowatts.

The main center of production, as in prior years, was the Estonian S.S.R., where estimated output totaled over 29 million tons in 1977 and is expected to be 30 million tons in 1980. There were eight underground mines and four open pits in operation in Estonia in 1977. During 1971-75 more than 100 million rubles was invested in the development of the Estonian oil shale industry. Most of Estonia's oil shale comes from a seam at a depth of 20 to 30 meters. An increasing proportion is obtained from open pits.

In 1977, three underground oil shale mines in Leningrad Oblast' produced some 5 million tons. Over 1 million tons of oil shale came from two underground mines in the Volga region.

Total Soviet economically minable oil shale reserves in place in categories A+B+C_1 (measured+indicated+inferred) in January 1978 were 6.4 billion tons, and 6 billion tons was classified as potential (category C_2). The largest oil shale reserves are in Estonia.

The average working thickness of the flat oil shale seams and the depth of mining, according to 1977 data, were as follows:

Basin	Number of workable seams	Seam thickness (meters)			Depth of mining (meters)
		Total	Oil shale	Limestone or clay	
Estonia	1	2.5-3.2	1.8-2.6	0.6-0.7 (limestone)	10-150
Leningrad	1	1.7-1.8	1.0-1.1	0.6-0.7 (limestone)	50-110
Volga region (Kashpira deposit)	1	2.0-2.4	1.1-1.2	0.8-1.2	NA

NA Not available.

Source: Ugol' (Coal). Moscow, No. 12, December 1977.

Peat.—The share of peat in total Soviet energy output increased from 5.3% in 1940 to 15% during World War II but had dropped to 0.8% in 1977.

The Soviet Union produced an estimated 192 million tons of peat in 1977. Of this quantity, 60 million tons consisted of fuel peat and 132 million tons are agricultural peat. The peat industry of the U.S.S.R. produced 41 million tons (55 million planned) of fuel peat and 34.8 million tons of agricultural peat in 1977. Estimated production of nearly 100 million tons of fuel peat (for domestic use of farmers) came from collective farms. Extraction of peat may reach 220 million tons (including 80 million tons of fuel peat) in 1980.

The Russian Soviet Federated Socialist Republic (R.S.F.S.R.) occupied first place in the production of peat in the U.S.S.R. and produced an estimated 130 million tons, including 42 million tons of fuel peat. During the 1971-75 period, 312 million rubles were invested in the development of the R.S.F.S.R.'s peat industry. The Belorussian S.S.R., with an estimated output of 46 million tons, was the second largest peat-producing region.

Soviet gross reserves of peat on January 1, 1976, were estimated at 166 billion tons (39 billion tons of standard fuel equivalent). However, about 11% of today's minable reserves are located in the Central European part of the U.S.S.R., Belorussia, the Baltic States, and the Ukraine regions, which produced over 80% of the national output in 1977.

Reserves in place and number of peat deposits, by Soviet Union Republic, on January 1, 1976, follow:

Republic	Number of deposits (thousands)	Reserves in place	
		Billion metric tons	Percent of total
R.S.F.S.R.	44.5	153.4	92.4
Belorussian S.S.R.	7.1	5.4	3.2
Estonian S.S.R.	1.0	2.3	1.4
Ukrainian S.S.R.	2.6	2.2	1.3
Latvian S.S.R.	5.1	1.7	1.0
Lithuanian S.S.R.	4.9	.9	.6
Georgian S.S.R.	.1	.1	.1
Total U.S.S.R.	65.3	166.0	100.0

Source: Izvestiya Academi: Nauk S.S.S.R.; Seriya Geograficheskaya, Moscow, Nov. 4, April 1978, p. 136.

There were 79 electric powerplants, with a total capacity of about 4,000 megawatts, fueled by peat, in operation in the U.S.S.R.

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in 1977. A number of new powerplants, with a capacity of 600 megawatts each, were being constructed in different regions of the U.S.S.R. in 1977. Fuel peat is also used in domestic heating.

[1]This publication is based on a review of the sources published by the U.S.S.R.

[2]Physical scientist, Branch of Foreign Data.

[3]Official exchange rate (December 1977) was 1 ruble = US$1.42. Approximate buying power of 1 ruble relative to prices in the United States for hard goods and food ranges from about $0.20 to $0.50.

[4]Pravda, Moscow, July 28, 1977, p. 1.

[5]Comecon (CMEA) - Council for Mutual Economic Assistance was founded in January 1949. The founder members were Bulgaria, Czechoslovakia, Hungary, Poland, Romania, and the U.S.S.R. Albania joined in February 1949 but ceased to take part in meetings in 1961. German Democratic Republic was admitted in 1950, Mongolia in 1962, and Cuba in 1972. Yugoslavia obtained permanent observer status in 1965.

[6]Metallurg (Metallurgist), Moscow, No. 7, July 1974, p. 1.

[7]Ekonomicheskaya gazeta (Economic Gazette), Moscow, No. 34, August 1976, p. 13.

[8]Sovetskiy shakhter (Soviet Miner), Moscow, No. 3, March 1975, p. 1.

[9]Trud (Labor), Moscow, No. 7, July 1974, p. 1.

Planovoye khozyaystvo (Planned Economy), Moscow, No. 1, January 1974, p. 32.

Ekonomicheskaya gazeta (Economic Gazette), Moscow, No. 7, July 1975, p. 3.

[10]Ekonomika neftyanoy promyshlennosti (Economics of Petroleum Industry), Moscow, No. 7, July 1975, p. 3.

[11]Trud (Labor), Moscow, Oct. 29, 1977, p. 2.

[12]Gornyy zhurnal (Mining Journal), Moscow, No. 11, November 1977, p. 21.

[13]Voprosy ekonomiki (Problems of Economics), Moscow, No. 10, October 1975, p. 9.

[14]Sovetskiy shakhter (Soviet Miner), Moscow, No. 6, June 1975, p. 3.

[15]Bezopasnost' truda v promyshlennosti (Labor Safety in Industry), Moscow, No. 4, April 1975, p. 3; No. 5, May 1975, pp. 4, 10, 16; No. 8, August 1975, pp. 7, 19.

Sovetskiy shakhter (Soviet Miner), Moscow, No. 6, June 1975, p. 2.

[16]Bezopasnost' truda v promyshlennosti (Labor Safety in Industry), Moscow, No. 1, January 1977, pp. 2-6; No. 2, February 1977, p. 3.

Sovetskiy shakhter (Soviet Miner), Moscow, No. 12, December 1976, p. 10.

[17]First work cited in footnote 16, No. 2, February 1977, pp. 46-48.

[18]First work cited in footnote 16, No. 1, January 1977, pp. 2-6; No. 2, February 1977, p. 19 and No. 7, July 1976, p. 58.

[19]First work cited in footnote 16, No. 7, July 1977, p. 28.

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[35]Pravda, Moscow, Nov. 18, 1977, p. 2.

[36]Tsvetnye metally (Nonferrous Metals), Moscow, No. 4, April 1977, pp. 1-11.

[37]Work cited in footnote 36.

[38]Work cited in footnote 36.

[39]Work cited in footnote 36.

[40]Work cited in footnote 36.

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[45]Narodnoye khozyaystvo Kazakhstana (National Economy of Kazakhstan), Alma-Ata, No. 3, March 1977, p. 28.

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[60]Work cited in footnote 59.

[61]Work cited in footnote 59.

[62]Ekonomicheskaya gazeta (Economic Gazette), Moscow, No. 30, July 1977.

[63]Work cited in footnote 59.

[64]Kommunist (Communist), Yerevan, Oct. 21, 1977, p. 2.

[65]Work cited in footnote 59.

[66]Work cited in footnote 59.

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[72]Tsvetnye metally (Nonferrous Metals), Moscow, No. 4, April 1977, pp. 1-11.

[73]Razvedka i okhrana nedr (Exploration and Conservation of Mineral Resources), Moscow, No. 10, October 1977, p. 5.

[74]Tsvetnye metally (Nonferrous Metals), Moscow, No. 5, May 1977, pp. 53-54.

[75]Narodnoye khozyaystvo Kazakhstana (National Economy of Kazakhstan), Alma-Ata, No. 12, December 1971, p. 89.

[76]The average content (nitrogen, phosphorus, and pot-

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ash) is expressed in Soviet standard units. Nitrogen is expressed as ammonia sulfate, 20.5% N, phosphate is expressed at 18.7% P_2O_5, potash is expressed as 41.6% K_2O, and ground rock phosphate (phosphatic flour) is expressed as 19% P_2O_5.

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[80]Work cited in footnote 79.

[81]Work cited in footnote 79.

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The Mineral Industry of the United Arab Emirates

By Candice Stevens[1]

The economy of the United Arab Emirates, comprising seven emirates, remained almost entirely dependent on the petroleum industry, which contributed more than 95% of total Government revenue. The petroleum income of the three oil-producing emirates—Abu Dhabi, Dubai, and Sharjah—was estimated at $9.7 billion[2] in 1977. The gross national product (GNP) in 1977 was approximately $11.5 billion, an increase of 19% over the 1976 GNP. More than 10% of the 1977 GNP was allocated to the Abu Dhabi Fund for Arab Economic Development (AFAED), established in 1971 to channel foreign aid to other Arab countries. The 1977 Federal budget of the United Arab Emirates was $3.4 billion, most of which was contributed by Abu Dhabi.

Abu Dhabi and Dubai, the largest oil producers and the wealthiest of the emirates, were to use their petroleum revenue in the construction of complete industrial cities. In 1977, Abu Dhabi contracted Fluor Corp. (United States) to provide planning and management services for the construction of infrastructure at Ruweis, situated near the crude oil loading facility at Jebel Dhanna. The industrial area of Ruweis is to include an oil refinery, a natural gas liquids (NGL) plant, a direct-reduction steel mill, a petrochemical complex, and a fertilizer plant. In Dubai, the new industrial city of Jebel Ali is to include an aluminum smelter, an NGL facility, a steel plant, a fertilizer plant, and a petroleum refinery.

In Sharjah, $50 million was allocated to industrial development under the direction of the newly formed investment company Sharjah Group Inc. Sharjah Co. for Heavy Industries was to supervise construction of a plant for the manufacture of steel and its products. Light industries, including a gypsum plant and a brick plant, were to be constructed by Gulf Industries Co.

Hunting Geology and Geophysics Ltd. (United Kingdom) was granted a second contract to do followup studies of a geological survey of the United Arab Emirates completed in 1976. The 15-month project is to include detailed geophysical analyses, mapping, and drilling. It is intended to evaluate the accessibility and quality of deposits of copper, chrome, sulfur, lead, and magnesium discovered during the 1975-76 survey.

PRODUCTION

Petroleum production increased slightly to approximately 2 million barrels per day in 1977. Abu Dhabi remained the largest producer, with an output of 1.65 million barrels per day. The other two producing emirates were Dubai (319,000 barrels per day) and Sharjah (28,000 barrels per day). Reserves in the three emirates were estimated at 32.4 billion barrels. Plans were made to exploit recent oil and gas discoveries in Ras al-Khaimah and Umm al-Qaiwain.

Marketed natural gas production in 1977 was approximately 3.2 billion cubic meters in Abu Dhabi and 0.7 billion cubic meters in Dubai. Trial production of NGL was initiated at Abu Dhabi's Das Island facility in mid-1977. Natural gas reserves in Abu

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Dhabi, Dubai, and Sharjah were estimated at 630 billion cubic meters. The only other mineral commodity produced in quantity in 1977 was cement for use by local construction industries.

Table 1.—United Arab Emirates:[1] Production of mineral commodities[2]

Emirate, commodity, and unit of measure	1975	1976	1977[p]
ABU DHABI			
Cement thousand metric tons	--	200	200
Gas, natural:			
Gross million cubic feet	432,002	544,196	541,760
Marketed[3] do	38,493	37,787	111,876
Natural gas liquids thousand 42-gallon barrels	--	--	8,411
Petroleum:			
Crude do	500,488	580,476	602,761
Refinery products:			
Gasoline do	--	554	1,073
Kerosine do	--	22	188
Distillate fuel oil do	--	963	1,390
Residual fuel oil do	--	702	1,045
Other do	--	9	37
Refinery fuel and losses do	--	127	306
Total do	--	2,377	4,039
AJMAN			
Marble[e] square meters	26,000	26,000	26,000
DUBAI			
Gas, natural:[e]			
Gross million cubic feet	102,000	127,600	165,800
Marketed do	20,000	20,000	26,000
Petroleum, crude thousand 42-gallon barrels	92,856	114,704	116,472
RAS AL-KHAIMAH			
Cement thousand metric tons	--	450	450
SHARJAH			
Cement do	--	--	50
Gas, natural:			
Gross million cubic feet	15,000	15,000	15,000
Marketed do	(4)	(4)	(4)
Petroleum, crude thousand 42-gallon barrels	13,943	13,542	10,293

[e]Estimate. [p]Preliminary.
[1]In addition to the emirates listed, Fujairah and Umm al-Qaiwain record no mineral production but presumably produce small quantities of crude construction materials.
[2]In addition to the commodities listed, crude construction materials (common clays, stone, and sand and gravel) presumably are also produced, but output is not recorded quantitatively and available general information is inadequate to make reliable estimates of output levels.
[3]Includes gas reinjected to reservoirs, if any.
[4]No marketed production reported; there is probably some small field use.

TRADE

Mineral trade consisted primarily of crude oil exports and imports of refined petroleum products and construction materials. The United Arab Emirates' balance-of-payments surplus was estimated at $5.5 billion in 1977. Almost all crude oil production was exported, principally to Japan, the United States, and Western Europe. The principal suppliers of imported goods were Japan (18%), the United Kingdom (17%), and the United States (14%).

Nearly 70% of imports were handled by Port Rashid in Dubai. Expansion of existing facilities and construction of seven new ports were expected to relieve congestion at United Arab Emirates terminals. The largest drydock in the world is scheduled to open in 1978 in Dubai, a new deepwater port was under construction at Jebel Ali, and Port Rashid was being expanded by five berths. In Abu Dhabi, new deepwater ports were to be constructed at Mina Zayed and Ruweis. An intermodal transportation system under development in Sharjah is to comprise two specialized container terminals at Port Khalid and Khor Fakkan. In Ras al-Khaimah, a deepwater port being built at Khor Kuwait is to be completed in 1978. In Umm al-Qaiwain, widening and deepening of the main port and construction of two new piers was in progress.

Abu Dhabi National Tanker Co. (ADNATCO) placed three general cargo ships on order to increase its total fleet capacity to 731,000 deadweight tons.

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COMMODITY REVIEW

METALS

Aluminum.—Construction began on the Dubai Aluminium Co. (DUBAL) smelter at Jebel Ali, Dubai. The smelter is to commence production in 1979 at 135,000 tons per year, rising to 180,000 tons per year by the early 1980's. Alcoa of Australia Ltd. is to supply 200,000 tons per year of alumina feedstock for a 10-year period. The Sunningdale Oils Ltd. gas plant under construction at Jebel Ali is to supply approximately 60 million cubic feet per day of dry gas to fuel the smelter. DUBAL was owned 80% by the Dubai government, 7.5% by Southwire Co. (United States), 7.5% by Nissho-Iwai Co., Ltd. (Japan), and 5% by various local interests.

Iron and Steel.—Feasibility studies were being conducted for a 400,000-ton-per-year direct-reduction steel mill for the new industrial city at Ruweis in Abu Dhabi. The plant, scheduled for startup in 1980, is to be fueled by associated natural gas from Abu Dhabi's onshore oilfields.

The Gulf Iron and Steel Co. plant in the al-Rashidiyah region of Dubai was commissioned in 1977. The plant, which produced iron and steel from scrap material, is to be expanded from the current capacity of 100 tons to 200 tons per day of reinforced iron bars by 1979. The plant used slag iron from the People's Republic of China, magnetite from Austria, and limestone from Pakistan.

NONMETALS

Cement.—The United Arab Emirates had a cement production capacity of approximately 920,000 tons per year, concentrated in three plants as follows:

Company	Location	Capacity (thousand metric tons per year)
Ittihad (Union) Cement Co	Al Ain, Abu Dhabi	200
	Ras al-Khaimah	500
Sharjah Cement Co	Sharjah	220

Cement production capacity was being expanded to meet heavy demand from the United Arab Emirates construction industry. Bids were being accepted from foreign companies for expansion of the Ittihad (Union) Cement Co. plant at Al Ain, Abu Dhabi. A factory to produce 56,000 tons per day of brick was under construction at Al Saad, near Al Ain.

In Ras al-Khaimah, cement production capacity is to reach 1 million tons per year by 1979 with the construction of a new cement plant at Khor Kuwait. The plant, which is to have a capacity of 1,400 tons per day, is to be built by Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI) of Japan.

Construction of the Dubai National Cement Co. Ltd. plant by Costain Civil Engineering (United Kingdom) continued on schedule, with startup planned for mid-1978. The plant is to have a capacity of 500,000 tons per year.

Construction began in September on an asbestos cement factory in Umm al-Qaiwain. The plant, which is to have a capacity of 40,000 tons per year of asbestos cement pipes, is to use imported asbestos and domestic limestone and gypsum.

Fertilizer Materials.—Abu Dhabi National Oil Co. (ADNOC) solicited bids for construction of a fertilizer complex for the Ruweis industrial area. The plant, which would use natural gas from Abu Dhabi's onshore fields as feedstock, is to produce 2,000 tons of ammonia and 1,500 tons of urea per day. Feasibility studies for the complex were completed in 1977 by SNAM Progetti S.p.A., a subsidiary of Ente Nazionale Idrocarburi (ENI) of Italy. The project is expected to go onstream in 1981.

MINERAL FUELS

Natural Gas.—The Das Island natural gas liquefaction facility operated by Abu Dhabi Gas Liquefaction Co. Ltd. (ADGLIC) was inaugurated on October 4. Designed to utilize 550 million cubic feet per day of associated gas from Abu Dhabi's offshore oilfields, the plant's annual capacity was 15 million barrels of liquefied natural gas (LNG), 5.6 million barrels of liquefied petroleum gas (LPG), 1.5 million barrels of light distillate, and 1.6 million barrels of pelletized sulfur. The entire production of LNG and LPG was earmarked for Tokyo Electric Power Co., Ltd., under an agreement con-

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cluded in December 1972.

In 1977, ADNOC issued contracts for construction of an NGL facility at Ruweis to process associated gas from Abu Dhabi's onshore oilfields. The required investment of $1.2 billion was to be financed entirely by the Abu Dhabi government after the failure of a former financing venture with the foreign partners in Abu Dhabi Petroleum Co. Ltd. (ADPC). Fluor Corp. was contracted to design and supervise gas-gathering facilities at the Bab, Bu Hasa, and Asab Fields. Bechtel Corp. (United States) was contracted for the design, procurement, and construction of two natural gas processing plants. The facility is to produce 185,000 barrels per day of NGL for export as well as dry gas to fuel powerplants and industrial projects in the Ruweis area. The facility, to be located in Jebel Dhanna, is expected to be in operation by 1980.

Dubai Natural Gas Co. (DUGAS), a joint venture of the Dubai government and Sunningdale, let contracts during the year for construction of an NGL-processing plant at Jebel Ali. The facility is to process 125 million cubic feet per day of associated gas from the offshore Fateh and Southwest Fateh Fields. Oceanic Contractors Inc., a subsidiary of J. Ray McDermott & Co., Inc. (United States), was contracted for design and engineering work on the NGL extraction plant and shipping facilities. The plant is to produce 7.3 million barrels per year of propane, butane, and natural gasoline. C. Itoh & Co., Ltd. (Japan) contracted to purchase nearly 60% of the output for a 15-year period. Dry gas sales were designated for the aluminum smelter under construction at Jebel Ali.

DUGAS also concluded an agreement during the year with the Umm al-Qaiwain government for development of a gasfield discovered offshore Umm al-Qaiwain in 1976. The bulk of output from the gasfield, which is to come onstream in 1979, is to be piped to the Jebel Ali aluminum smelter for use as fuel; a small proportion of production is to be reserved for use in Umm al-Qaiwain. DUGAS further agreed to finance the engineering and construction costs of a power and desalting plant in Umm al-Qaiwain.

Petroleum.—*Abu Dhabi.*—Government-owned ADNOC maintained 60% participation in the two major oil companies, ADPC and Abu Dhabi Marine Areas, Ltd. (ADMA). In April, a formal agreement was concluded between ADNOC and the shareholders of ADMA giving the Abu Dhabi government effective participation in planning and decisionmaking in proportion to its 60% shareholding. ADNOC continued to market increasing quantities of crude oil on its own account and announced plans to further reduce the quantity of crude oil sold back to the two concessionaire companies in 1978.

ADNOC scheduled a change in petroleum production ceilings, which were first imposed in 1974 for conservation purposes. Allowable output for the ADPC fields is to be reduced from 1,035,000 barrels per day in 1977 to 850,000 barrels per day in 1978. The ADMA production ceiling is to be lowered from 550,000 barrels per day in 1977 to 500,000 barrels per day in 1978.

Onshore, ADPC continued development drilling and water injection programs to maintain production capacity in its four fields, all linked by pipeline to the loading facilities at Jebel Dhanna. Production from the Bab, Bu Hasa, Asab, and Sahil Fields was maintained at the 1976 level of 1,020,000 barrels per day in 1977. The new Shah Field, located south of the Asab Field, is to be brought onstream in 1979 with an initial production capacity of 50,000 barrels per day.

Offshore, the Umm Shaif and Zakum Fields operated by ADMA increased production 16% to 521,000 barrels per day in 1977. Work began on the installation of a supercomplex to give a water injection capacity of 500,000 barrels per day at the Zakum Field; a similar water injection scheme was completed in 1976 at the Umm Shaif Field.

Abu Dhabi's three other producing offshore oilfields were under development to increase production capacity. The Abu Al Bu Koosh Field, operated by a consortium including Sunningdale and Amerada Hess Corp., evidenced a decrease in output to 74,000 barrels per day in 1977. Production at the smaller Mubarraz Field, operated by the Japanese consortium Abu Dhabi Oil Co., Ltd. (ADOCO), was approximately 21,000 barrels per day in 1977. The El Bunduq Field, owned jointly by British Petroleum Co. Ltd. (BP), Cie. Française des Pétroles (CFP), and United Petroleum Development Co., Ltd., of Japan, produced 19,000 barrels per day in 1977; associated gas was delivered to the Das Island natural gas liquefaction plant.

Production from Amerada Hess' Arzanah Field is scheduled to begin in late 1978.

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Twelve development wells were completed in 1977 as part of a $140 million development program. Discovered in 1973, the Arzanah Field is to have an initial production capacity of 40,000 barrels per day.

ADNOC concluded joint venture agreements to develop three other offshore oilfields. Zakum Development Co. was formed by ADNOC (88%) and Japan Oil Development Co. (JODCO) (12%) to exploit the Upper Zakum Field. CFP was designated as operator of the field and was to provide personnel, management expertise, and equipment on a fee basis, with an option to purchase a proportion of output. Production from the Upper Zakum Field is expected to reach 350,000 barrels per day. JODCO also acquired a 12% share in the Saath al-Razboot and Umm al-Dalkh Fields, which are to begin production in 1979 with CFP as operator. Saath al-Razboot is expected to have a production capacity of 100,000 barrels per day, while output from Umm al-Dalkh is to total 50,000 barrels per day.

ADNOC's 15,000-barrel-per-day refinery on Umm al-Nar Island is to be expanded to 50,000 barrels per day by 1979. SNAM Progetti was contracted for construction of a $500 million refinery at Ruweis. Scheduled for completion at yearend 1980, the refinery is to have a production capacity of 120,000 barrels per day of petroleum products.

Table 2.—Abu Dhabi: Exports of crude oil, by destination

(Thousand 42-gallon barrels)

Country	1975	1976[r]	1977
Australia	1,606	220	2,081
Canada	7,154	2,855	--
France	84,972	76,128	72,708
Germany, Federal Republic of	14,564	17,934	32,741
Italy	7,373	14,384	11,899
Japan	[r]146,621	192,004	191,005
Netherlands	72,124	66,758	87,126
United Kingdom	52,268	38,357	25,842
United States	35,588	80,557	101,580
Yemen, People's Democratic Republic of	876	--	--
Other	76,466	89,961	74,604
Total	[r]499,612	579,158	599,586

[r]Revised.

Source: Organization of Petroleum Exporting Countries, Statistics Unit. Annual Statistical Bulletin 1977 (Vienna). 1978, p. 74.

Ajman.—No exploration activity was reported in 1977. United Refining Co. (United States), the last concession holder in Ajman's offshore area, dropped its concession in late 1975.

Dubai.—The Fateh and Southwest Fateh Fields, owned by Dubai Petroleum Co. (DPC), produced 319,000 barrels per day of crude oil in 1977. Expansion of the water injection system in the two fields is to raise production capacity from 345,000 barrels to 460,000 barrels per day.

DPC continued development of the Falah and Rashid Fields, situated west of the Fateh Field near the Abu Dhabi offshore boundary. The Falah Field is expected to have an initial production capacity of 15,000 barrels per day of crude oil. The Rashid Field is expected to produce 20 million cubic feet per day of nonassociated gas and some condensate for use in the Jebel Ali industrial area. A third discovery west of the Fateh Field tested 2,500 barrels per day of oil from two zones in 1977.

Houston Oil & Minerals Corp. (50%), in conjunction with Southeastern Drilling Co. (50%), acquired a 6,000-square-kilometer concession area in Dubai during 1977. The area included 4,000 square kilometers onshore and 2,000 square kilometers offshore, both having been relinquished by Texas Pacific Dubai Inc. Geophysical work was scheduled to begin in mid-1978 in both the onshore and offshore acreage.

Fujairah.—Reserve Oil & Gas Co. (United States), which held a 1,500-square-kilometer concession in the Gulf of Oman, drilled its first well approximately 18 kilometers off Fujairah's eastern coast. Further development drilling was scheduled for 1978.

Ras al-Khaimah.—Ras al-Khaimah Oil Co. (RKOC) commissioned J. Ray McDermott to carry out engineering studies for production installations at two offshore

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oil discoveries. During 1977, RKOC acquired a 50% interest in the fields discovered by an international consortium operated by Deutsche Schachtbau- und Tiefbohrgesellschaft mbH (Federal Republic of Germany). Drilling was in progress on both the B-1 well, which tested 4,000 barrels per day of oil, and the A-1 well, which tested 2,500 barrels per day of oil and 17 million cubic feet per day of gas.

RKOC (51%) and Kuwait National Petroleum Co. (49%) formed a joint venture for construction of a petroleum refinery in Ras al-Khaimah. Kellogg Co. (United States) was commissioned to prepare a feasibility study for the refinery.

Sharjah.—Production from the Mubarek Field, operated by Crescent Petroleum Co., declined from 37,500 barrels per day in 1976 to 30,000 barrels per day in 1977. A gas-lift system was being installed at Mubarek to boost flow to the targeted output of 60,000 barrels per day. At yearend, Sharjah unilaterally raised the tax rate from 55% to 77% and the royalty rate from 12.5% to 14.5% on the Mubarek Field, retroactive to July 1, 1976. The new provisions were the subject of negotiations between Crescent and the Sharjah government.

Umm al-Qaiwain.—The Umm al-Qaiwain Oil Group, with Zapata Exploration Co. (United States) as operator, conducted followup studies on two oil and gas discoveries in the offshore area. One well tested 130 barrels per day of oil and 15 million cubic feet per day of gas, and the other tested 345 barrels per day of oil and 26 million cubic feet per day of gas. Onshore, Houston drilled several wells without commercial discovery.

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[1]Economist, Branch of Foreign Data.

[2]Where necessary, values have been converted from United Arab Emirates dirhams (UAED) to U.S. dollars at the rate of UAED3.84 = US$1.00.

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The Mineral Industry of the United Kingdom

By William F. Keyes[1]

Growing North Sea oil production brought about a significant improvement in Britain's financial environment in 1977; exports were strong and the exchange rate firmed, foreign currency reserves grew, and interest rates declined. However, the basic performance of the real economy, apart from the peripheral but vital oil sector, remained disappointing, and industrial production failed to demonstrate any strength. The experience of the United Kingdom in this regard was similar to that of other countries, such as the Netherlands and Norway, that found sudden wealth in natural resources to be a mixed blessing.

The United Kingdom continued to be deficient in most of the major extracted minerals. Only in energy sources (coal, crude oil, and natural gas) and ultimately perhaps in potash, was the supply picture promising. The country possessed, however, a major minerals processing capacity and was a major world source and consumer of iron and steel products, nonferrous metals, and processed nonmetallic minerals of domestic and foreign origin, such as potash, clay, fertilizers, and cement. During the year a possible major domestic source of tungsten was explored, a significant petroleum find was made onshore, growth in offshore petroleum activity continued strong, and coal mine development proceeded apace.

PRODUCTION

By yearend, production of crude oil from North Sea fields was close to 1 million barrels per day, equivalent to half the country's consumption, and production was increasing steadily to an expected self-sufficiency early in the 1980's.

Production of other United Kingdom major minerals and metals was less satisfactory. Coal production was at the lowest nonstrike level since World War II; steel production and sales were disastrously low; and the sole potash mine (the largest other than coal and iron) was beset with severe production problems.

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Table 1.—United Kingdom: Production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Aluminum:			
Alumina	83	96	99
Metal:			
Primary	308	335	349
Secondary	176	206	201
Antimony, primary smelter—metric tons	NA	NA	NA
Cadmium metal, including secondary—do.	[r]275	190	295
Copper:			
Ore and concentrate, metal content—do.	[r]700	600	450
Refined:			
Primary—do.	75,500	51,600	44,400
Secondary—do.	76,000	85,700	76,100
Iron and steel:			
Iron ore	4,490	4,582	3,745
Pig iron	12,046	13,713	12,138
Ferroalloys, blast furnace:			
Ferromanganese	85	122	97
Steel:			
Crude	20,198	22,274	20,411
Semimanufactures:			
Sections	4,765	5,238	4,878
Wire rods	1,415	1,538	1,650
Plates and sheets	6,217	7,144	6,821
Strip	1,031	1,264	1,134
Pipe, tube, stock	828	711	687
Railway track material	344	226	262
Other rolled[1]	973	978	1,081
Castings and forgings	391	360	338
Total	15,964	17,459	16,851
Lead:			
Mine output, metal content—metric tons	[r]6,400	7,100	7,753
Metal:			
Bullion from imported ores and concentrates—do.	25,700	16,500	35,000
Refined:			
Primary[2]—do.	[r]117,900	132,200	139,700
Secondary[3]—do.	123,400	119,300	124,800
Total—do.	[r]241,300	251,500	264,500
Magnesium metal, including secondary—do.	2,800	3,000	2,700
Nickel metal, refined, including ferronickel—do.	37,300	33,100	23,200
Silver metal—thousand troy ounces	[r]141	108	134
Tin:			
Mine output, metal content—metric tons	[r]3,300	4,000	2,813
Metal:			
Primary—do.	11,500	9,850	10,500
Secondary—do.	3,561	2,800	3,400
Tungsten, mine output, metal content—do.	10	[e]10	78
Zinc:			
Ore and concentrate, metal content—do.	4,001	4,800	7,551
Smelter—do.	53,400	41,600	81,500
NONMETALS			
Barite and witherite	[r]52	50	50
Bromine—metric tons	28,300	29,900	24,700
Calcite	19	16	14
Cement, hydraulic	16,891	15,780	15,456
Chalk	[r]17,924	15,941	16,253
Clays:			
Fire clay	[r]1,606	1,513	1,764
Fuller's earth	164	201	223
Kaolin (china clay)	3,220	3,847	4,338
Potters' and ball clay	12	14	16
Other, including clay shale	[r]28,005	26,229	24,378
Diatomite—metric tons	[r]4,000	3,500	2,000
Feldspar (china stone)[e]—do.	50,000	50,000	50,000
Fertilizers, manufactured:[4]			
Nitrogenous (N content)	[r]885	821	NA
Phosphatic (P_2O_5 content)	[r]445	393	NA
Other, gross weight	[r]2,674	2,855	NA
Fluorspar:			
Acid grade	127	134	105
Metallurgical grade	33	54	58
Ungraded	19	29	31
Total	179	217	194
Gypsum, plaster, anhydrite[5]	3,479	3,350	3,310
Mica	--	1	--

See footnotes at end of table.

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Table 1.—United Kingdom: Production of mineral commodities —Continued

(Thousand metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
NONMETALS —Continued			
Refractory products:[6]			
Bricks	824	809	768
Cement	62	64	61
Other	417	457	452
Salt:			
Rock	754	611	905
Brine	1,740	1,918	1,871
Other	5,136	5,477	5,426
Stone, sand and gravel:			
Stone:			
Chert and flint	[r]362	322	39
Igneous rock	[r]42,017	37,215	35,613
Limestone and dolomite	[r]95,213	89,364	85,992
Sandstone, including ganister	[r]13,394	13,522	11,755
Slate	[r] 547	295	1,824
Sand and gravel:			
Common sand and gravel	[r]125,000	117,700	110,063
Special sands	[r]6,139	5,678	3,288
Strontium minerals metric tons	1,900	5,400	5,100
Sulfur:			
Elemental	58	77	76
Sulfuric acid	3,166	3,271	3,405
Talc, soapstone, pyrophyllite metric tons	19,100	14,800	15,000
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	209	214	193
Coal:			
Anthracite	2,534	2,363	2,529
Bituminous	125,286	119,845	118,145
Other	858	1,592	1,426
Coke:			
Metallurgical	15,859	15,754	11,518
Gashouse	(7)	--	--
Breeze, all types	1,187	1,164	1,070
Fuel briquets, all grades	1,190	NA	2,679
Gas:			
Manufactured[8] million therms	211	NA	33
Natural:			
Gross production million cubic feet	NA	NA	1,560,124
Marketed production do	[r]1,273,936	1,316,358	1,416,041
Natural gas liquids thousand 42-gallon barrels	3,240	5,721	4,489
Petroleum:			
Crude, including field condensate do	8,902	84,655	278,838
Refinery products:			
Gasoline:			
Aviation do	2,311	2,127	425
Motor do	118,541	129,472	149,721
Jet fuel do	28,809	33,304	33,904
Kerosine do	20,446	19,050	20,592
Distillate fuel oil do	174,000	180,517	141,468
Residual fuel oil do	217,953	217,749	152,133
Lubricants do	7,985	9,170	7,319
Other do	74,944	82,987	81,454
Refinery fuel and losses do	44,843	48,737	50,939
Total do	689,832	723,113	637,955

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]Includes wheels, centers, tires, axles, and semimanufactures for sale.

[2]Lead refined from imported bullion.

[3]Lead refined from scrap materials and domestic ores.

[4]Year ending May 31 of that stated.

[5]Excludes plasters.

[6]Consists of bricks, retorts, molds, and other refractory products made from clays, silica, siliceous material, magnesite, alumina, and chrome materials.

[7]Less than 1/2 unit.

[8]Gas made at gas works plus purchased coke oven refinery gas.

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TRADE

As a major world trading nation and processor of raw materials, the United Kingdom's economy is closely related to that of the United States. The United Kingdom ships steel semimanufactures and processed nonferrous metals to the United States and receives in return coking coal, ferrous scrap, aluminum, copper, phosphate rock, and lubricants. As shown in table 4, the value of United States-United Kingdom minerals trade, as defined by the entries, totaled $1.2 billion in 1976. The minerals commodity trade of the United Kingdom in 1975-76 is given in tables 2-3.

Table 2.—United Kingdom: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Bauxite and concentrate	396	97	NA.
Oxide and hydroxide	24,669	43,024	Sweden 9,267; Spain 4,686.
Metal including alloys:			
Scrap	16,720	7,021	West Germany 3,132; Netherlands 1,685.
Unwrought	87,695	162,085	Netherlands 68,096; Belgium-Luxembourg 20,788; West Germany 19,102.
Semimanufactures	54,313	62,486	France 6,524; Ireland 5,683; West Germany 5,139.
Antimony metal[1]	NA		
Arsenic trioxide, pentoxide, acid	2,608	2,325	New Zealand 1,319.
Beryllium metal including alloys, all forms	6	3	NA.
Bismuth metal including alloys[1]	r313	285	NA.
Cadmium metal including scrap[1]	r165	105	NA.
Chromium:			
Chromite	2,851	965	NA.
Oxide and hydroxide value, thousands	r$1,844	$911	NA.
Metal including alloys, all forms	r3,900	3,900	NA.
Cobalt:			
Oxide and hydroxide	149	634	NA.
Metal including matte, speiss, etc.[1]	r600	2,000	NA.
Columbium and tantalum metal including alloys, all forms: Tantalum	63	5	NA.
Copper:			
Ore and concentrate	r30	NA	
Metal including alloys:			
Scrap	35,323	38,772	West Germany 15,953; Italy 13,656.
Unwrought	43,754	32,980	West Germany 9,150; France 3,295.
Semimanufactures	122,578	101,907	Switzerland 14,664; Ireland 9,079; Sweden 8,244.
Gold, unworked or partly worked:			
Bullion refined thousand troy ounces	r16,532	18,121	NA.
Other do.	r9	3	NA.
Iron and steel:			
Ore and concentrate, except roasted pyrite	249	383	NA.
Metal:			
Scrap thousand tons	916	599	Spain 197; Italy 184; West Germany 95.
Pig iron, ferroalloys, and similar materials do.	61	104	Italy 15; West Germany 9; Netherlands 8.
Steel, primary forms do.	256	258	Italy 80; West Germany 46; United States 38.
Semimanufactures:			
Bars, rods, angles, shapes, sections:			
Wire rod thousand tons	160	209	United States 30; Turkey 23; Sweden 20.
Other bars and rods do.	530	661	United States 96; West Germany 75.
Angles, shapes, sections do.	542	582	United States 155.
Universals, plates, sheets:			
Universals and heavy plates, uncoated do.	181	302	West Germany 236; United States 38; India 33.

See footnotes at end of table.

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Table 2.—United Kingdom: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Iron and steel —Continued			
Metal —Continued			
Semimanufactures —Continued			
Universals, plates, sheets — Continued			
Medium plates and sheets, uncoated thousand tons	10	25	Ireland 9.
Light plates and sheets, uncoated do	298	305	Sweden 52; United States 32.
Tinned plates and sheets do	206	231	India 36; Argentina 17; Greece 17.
Other coated plates and sheets do	147	205	Norway 31; Sweden 19; West Germany 16.
Hoop and strip do	99	122	France 12; Ireland 12; West Germany 11.
Rails and accessories do	136	129	New Zealand 21; France 13.
Wire do	111	113	United States 23; Canada 16.
Tubes, pipes, fittings do	562	565	Sweden 42; Netherlands 40; Ireland 36.
Castings and forgings, rough do	70	60	United States 21; Sweden 14.
Total do	3,052	3,509	
Lead:			
Ore and concentrate	10,414	9,272	Belgium-Luxembourg 3,789.
Oxides	8,265	8,321	Ireland 2,939; Sweden 970.
Metal including alloys:			
Scrap	19,069	11,599	Italy 5,597; Ireland 2,525.
Unwrought	106,606	103,665	West Germany 21,495; Netherlands 17,999; Portugal 11,053.
Semimanufactures	3,203	2,446	NA.
Magnesium metal including alloys:			
Scrap	303	259	NA.
Unwrought	1,166	968	France 429; United States 190.
Semimanufactures	530	636	Republic of South Africa 83.
Manganese:			
Ore and concentrate	3,803	8,087	NA.
Oxides	4,079	2,205	West Germany 128.
Mercury 76-pound flasks	1,479	1,131	NA.
Molybdenum metal including alloys, all forms	128	121	Netherlands 26.
Nickel:			
Matte, speiss and similar materials	774	72	Norway 25.
Metal including alloys:			
Scrap	4,042	5,543	West Germany 2,192; Sweden 708.
Unwrought	31,484	29,669	West Germany 8,631; France 4,485; Sweden 3,882.
Semimanufactures	10,385	10,101	West Germany 1,282; France 1,127.
Platinum-group metals and silver:			
Ore and concentrate value, thousands	r$8	$50	NA.
Waste and sweepings do	r$4,507	$3,569	West Germany $1,088; Belgium-Luxembourg $354.
Metals including alloys:			
Platinum group thousand troy ounces	1,029	1,286	United States 418; West Germany 257; Japan 257.
Silver:			
Refined do	r51,036	68,613	NA.
Other do	1,256	247	NA.
Tin:			
Ore and concentrates	2,819	185	Spain 90.
Oxides	745	540	United States 106; Brazil 66.
Metal including alloys:			
Scrap	68	99	NA.
Unwrought	14,574	10,235	Netherlands 3,049; U.S.S.R. 1,063.
Semimanufactures	1,013	1,001	Norway 223; Sweden 57.
Titanium oxides	6,246	10,502	Ireland 1,256; Japan 1,190; Poland 1,017.
Tungsten:			
Ore and concentrate	189	206	West Germany 29.
Metal including alloys, all forms	687	337	West Germany 138.
Uranium and thorium metals including alloys, all forms kilograms	6,000	6,000	NA.
Zinc:			
Ore and concentrate	25,280	7,495	Sweden 7,480.
Oxide and peroxide	7,808	9,300	Belgium-Luxembourg 2,236.
Metal including alloys:			
Scrap	5,240	3,966	West Germany 1,476; France 1,114.
Unwrought	17,877	13,205	Netherlands 2,139; Ireland 2,126; Portugal 1,515.
Semimanufactures	4,240	3,587	Ireland 1,004.

See footnotes at end of table.

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Table 2.—United Kingdom: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Other:			
Ore and concentrate:			
Of molybdenum, tantalum, titanium, vanadium, zirconium	r18,113	2,551	Belgium-Luxembourg 456; France 201.
Of base metals, n.e.s. value, thousands	r$186	$5	NA.
Ash and residue, containing nonferrous metals	49,184	45,539	West Germany 20,603; Canada 9,396; Belgium-Luxembourg 5,783.
Oxides, hydroxides, and peroxides of metals, n.e.s	99,754	47,407	Spain 18,545; Italy 8,694.
Metals including alloys, all forms:			
Metalloids, n.e.s. value, thousands	r$2,392	$1,401	Republic of South Africa $57.
Alkali, alkaline earth, and rare-earth metals	171	68	NA.
Pyrophoric alloys	567	353	NA.
Base metals including alloys, all forms, n.e.s	7,326	7,630	United States 2,587; France 967.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	5,584	3,120	NA.
Dust and powder of precious and semiprecious stones value, thousands	r$7,761	$3,564	Ireland $663; Japan $548; Netherlands $514.
Grinding and polishing wheels and stones	8,010	8,205	West Germany 994; Sweden 970.
Asbestos, crude and waste	1,698	1,996	NA.
Barite and witherite	3,993	6,629	NA.
Boric oxide and acid	256	154	NA.
Cement thousand tons	1,121	1,036	Ivory Coast 248; Nigeria 172.
Chalk	35,976	45,263	Nigeria 6,553.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s thousand tons	2,190	2,487	West Germany 408; Italy 391; Finland 296.
Products:			
Refractory (including nonclay brick) do	341	261	Italy 44; Sweden 34.
Nonrefractory do	89	97	Canada 11; Australia 10; United States 8.
Cryolite and chiolite	NA	1	NA.
Diamond, all grades value, millions	r$1,695	$726	Switzerland $275; Belgium-Luxembourg $223; United States $83.
Diatomite and other infusorial earth	1,863	2,220	NA.
Feldspar and fluorspar	51,275	37,164	Norway 19,487; Netherlands 4,748.
Fertilizer materials:			
Crude:			
Nitrogenous	340	142	NA.
Phosphatic	141	96	NA.
Potassic	11	NA	
Other	2,824	2,475	NA.
Manufactured:			
Nitrogenous thousand tons	154	140	Ireland 59; Netherlands 23.
Phosphatic	r118,466	136,993	Bangladesh 64,839; Ireland 28,580.
Potassic	4,428	24,070	NA.
Other including mixed	406,254	453,112	Ireland 129,560; Belgium-Luxembourg 102,611; West Germany 64,450.
Graphite, natural	2,795	1,717	NA.
Gypsum and plasters	r14,721	15,204	NA.
Lime	37,210	38,395	Nigeria 14,344; Ireland 4,593.
Magnesite	48,385	42,126	Poland 12,155; Netherlands 8,003; West Germany 2,091.
Mica:			
Crude including splitting and waste	1,603	2,500	NA.
Worked including agglomerated splitting	156	190	France 17.
Pigments, natural:			
Natural crude	3,681	4,392	NA.
Iron oxides, processed	8,199	7,728	Nigeria 101; Iraq 64.
Precious and semiprecious stone, except diamond:			
Natural value, thousands	r$44,628	$16,937	Switzerland $5,550; Hong Kong $2,446; West Germany $1,943.

See footnotes at end of table.

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Table 2.—United Kingdom: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Precious and semiprecious stone, except diamond —Continued			
Manufactured value, thousands	r$162	$147	NA.
Salt thousand tons	519	576	Sweden 190; Nigeria 138.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	250,740	271,874	Australia 142,026.
Caustic potash, sodic and potassic peroxides	310	733	NA.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	6,221	13,687	NA.
Worked	11,976	6,989	NA.
Dolomite, chiefly refractory grade	12,086	10,790	NA.
Gravel and crushed rock thousand tons	4,105	4,618	Belgium-Luxembourg 1,656; Netherlands 1,385; France 1,222.
Limestone (except dimension)	9,500	15,418	NA.
Quartz and quartzite	110	328	NA.
Sand excluding metal bearing	69,841	71,561	Ireland 21,047; Norway 8,062.
Strontium minerals, celestite[1]	r1,300	3,800	NA.
Sulfur:			
Elemental:			
Other than colloidal	1,941	1,768	NA.
Colloidal	75	195	NA.
Sulfur dioxide value, thousands	r$51	$16	NA.
Sulfuric acid	165,831	44,525	Ireland 33,991; Morocco 5,247.
Talc, steatite, soapstone, pyrophyllite	1,642	2,894	NA.
Other nonmetals, n.e.s.:			
Crude	r820,716	803,182	Norway 234,061; Belgium-Luxembourg 205,130; West Germany 171,196.
Slag, dross and similar waste, not metal bearing:			
From iron and steel manufactures	138,441	145,950	West Germany 138,415.
Slag and ash, n.e.s	2,470	1,911	NA.
Oxides and hydroxides of magnesium, strontium, barium	30,531	10,881	West Germany 3,603; Sweden 1,693.
Halogens other than chlorine	1,840	1,637	West Germany 378; Switzerland 190; France 188.
Building materials of asphalt, asbestos and fiber cement, and unfired nonmetals, n.e.s	74,342	106,857	NA.
MINERAL FUELS AND OTHER RELATED MATERIALS			
Asphalt and bitumen, natural	1,379	2,898	NA.
Carbon black	32,200	42,536	Ireland 7,449.
Coal and briquets:			
Anthracite and bituminous coal thousand tons	2,182	1,436	France 460; Belgium-Luxembourg 263; West Germany 253.
Briquets of anthracite and bituminous coal do	284	233	Norway 211.
Lignite and lignite briquets	80	466	NA.
Coke and semicoke thousand tons	1,315	948	Sweden 261; Norway 229; Netherlands 117.
Hydrogen and rare gases	1,072	3,353	NA.
Peat including peat briquets and litter	1,786	1,580	NA.
Petroleum:			
Crude and partly refined:			
Crude thousand 42-gallon barrels	r5,320	22,834	Sweden 4,256; Ireland 4,074; West Germany 3,843.
Partly refined do	r1,939	574	Netherlands 465.
Refinery products:			
Gasoline (including natural) do	r20,664	21,293	Ireland 5,304; Netherlands 4,803; Sweden 4,624.
Kerosine and jet fuel do	r5,999	6,371	Ireland 2,984; Denmark 1,031; Norway 674.
Distillate fuel oil do	r41,619	46,185	Denmark 10,593; Netherlands 9,042; Sweden 8,667.
Residual fuel oil do	r24,895	35,158	Ireland 8,731; Sweden 5,548; Denmark 4,276.
Lubricants do	r4,482	5,096	West Germany 581; Algeria 448.

See footnotes at end of table.

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Table 2.—United Kingdom: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
MINERAL FUELS AND OTHER RELATED MATERIALS —Continued			
Petroleum —Continued			
Refinery products —Continued			
Other:			
Liquefied petroleum gas thousand 42-gallon barrels	r2,111	3,735	Ireland 1,079; Spain 661; Portugal 557.
Mineral jelly and wax do	r142	236	Netherlands 55; Nigeria 39.
Nonlubricating oil, n.e.s do	r266	287	Netherlands 42; Republic of South Africa 35; Australia 28.
Bitumen and other residues and bituminous mixtures, n.e.s. do	r1,037	867	Ireland 61; Iran 55.
Pitch, pitch coke, and petroleum coke do	1,755	996	Norway 297; Sweden 61.
Total do	r102,970	120,224	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	187,968	118,298	Norway 14,825; France 14,587; Netherlands 14,097.

rRevised. NA Not available.

[1]Source: Institute of Geological Sciences, United Kingdom Mineral Statistics, 1977. London.

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Table 3.—United Kingdom: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite and concentrate thousand tons	296	297	Ghana 197; Greece 53.
Oxide and hydroxide do	558	526	Jamaica 283.
Metal including alloys:			
Scrap do	14	17	Ireland 1.
Unwrought do	160	218	Norway 110; Iceland 31.
Semimanufactures do	79	162	United States 23; West Germany 14; Belgium-Luxembourg 12.
Arsenic trioxide, pentoxide, acids	5,120	4,879	Republic of South Africa 1,725.
Beryllium metal including alloys, all forms	8	6	All from United States.
Bismuth metal including alloys, all forms[1]	r353	327	NA.
Cadmium metal including alloys, all forms[1]	r913	1,309	NA.
Chromium:			
Chromite thousand tons	144	138	Republic of South Africa 103.
Oxide and hydroxide value, thousands	r$370	$318	U.S.S.R. $101.
Cobalt:			
Oxide and hydroxide	884	807	Canada 782.
Metal including alloys, all forms[1]	r2,200	2,300	NA.
Columbium and tantalum: Tantalum metal including alloys, all forms	27	57	United States 31; Belgium-Luxembourg 7.
Copper:			
Ore and concentrate	r307	1459	NA.
Matte	NA	32	NA.
Metal including alloys:			
Scrap	10,237	13,135e	Ireland 3,044; Chile 1,100; United States 1,063.
Unwrought	451,858	433,914	Zambia 89,290; Canada 87,944; Chile 79,398.
Semimanufactures	23,895	34,092	West Germany 7,749; France 5,802; Finland 4,084.
Gold, unworked or partly worked:			
Bullion:			
Refined thousand troy ounces	15,407	19,373	NA.
Unrefined do	311	228	NA.
Other do	1	1	NA.
Iron and steel:			
Ore and concentrate, except roasted pyrite thousand tons	15,783	18,589	Canada 3,821; Sweden 3,201; Brazil 3,186.
Roasted pyrite do	304	225	Sweden 198.
Metal:			
Scrap do	88	694	United States 473; West Germany 83.
Pig iron including cast iron, sponge, powder, and shot do	88	221	Norway 36; Finland 24; Brazil 23.
Ferroalloys:			
Ferromanganese do	96	118	Republic of South Africa 54; Norway 46.
Other do	230	271	Norway 111; Sweden 44.
Steel, primary forms do	622	940	West Germany 151; Netherlands 131.
Semimanufactures:			
Bars, rods, angles, shapes, sections:			
Wire rods do	141	138	Netherlands 36; West Germany 25; France 19.
Other bars and rods do	277	301	Norway 53; Sweden 46; Netherlands 34.
Angles, shapes, sections do	r100	161	Belgium-Luxembourg 22; Japan 20; Ireland 17.
Universals, plates, sheets:			
Heavy and medium plates and sheets, uncoated do	689	590	West Germany 123; Italy 92; Sweden 84.
Light plates and sheets, uncoated do	853	1,085	Netherlands 283; West Germany 229; Belgium-Luxembourg 154.
Tinned plates and sheets do	57	142	Netherlands 71; France 21.
Other coated plates and sheets do	145	277	West Germany 99; Belgium-Luxembourg 59; France 32.
Hoop and strip do	106	80	West Germany 26; Poland 15; Sweden 9.
Rails and accessories do	1	1	NA.
Wire do	22	25	Belgium-Luxembourg 6; Sweden 5; West Germany 4.

See footnotes at end of table.

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Table 3.—United Kingdom: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Iron and steel —Continued			
Metal —Continued			
Semimanufactures —Continued			
Tubes, pipes, fittings thousand tons	753	388	Netherlands 89; West Germany 80; Italy 64.
Castings and forgings, rough do	20	20	West Germany 5; Portugal 3; Japan 2.
Total do	3,164	3,208	
Lead:			
Ore and concentrate do	r45	12	Canada 4; Peru 2; Republic of South Africa 2.
Oxides	114	183	NA.
Metal including alloys:			
Scrap	1,597	1,839	NA.
Unwrought thousand tons	202	252	Australia 211; Canada 37.
Semimanufactures	1,202	1,331	Netherlands 266.
Magnesium metal including alloys:			
Scrap	381	377	NA.
Unwrought	4,405	5,933	Norway 2,590; Netherlands 2,100; Canada 1,031.
Semimanufactures	253	242	West Germany 32.
Manganese:			
Ore and concentrate thousand tons	253	500	Republic of South Africa 208; Brazil 110; Ghana 68.
Oxides	2,746	4,853	Japan 3,414.
Metal[1]	r4,300	4,300	NA.
Mercury 76-pound flasks	21,350	11,835	United States 116; West Germany 58; France 58.
Molybdenum:			
Ore and concentrate[1]	r13,528	13,617	NA.
Metal including alloys, all forms	170	132	Austria 97; United States 17.
Nickel:			
Matte, speiss, and similar materials	66,876	54,759	Canada 51,062.
Metal including alloys:			
Scrap	2,705	4,253	West Germany 1,120; United States 775; France 606.
Unwrought	23,931	20,355	Canada 13,892.
Semimanufactures	5,701	3,751	Canada 1,175; United States 875; West Germany 848.
Platinum-group metals and silver:			
Ore and concentrate value, thousands	r$112,514	$34,658	NA.
Waste and sweepings do	r$48,110	$27,747	United States $12,195.
Metals including alloys:			
Platinum group thousand troy ounces	r192	257	Republic of South Africa 129; U.S.S.R. 64.
Silver:			
Refined do	r50,631	17,001	NA.
Unrefined do	r26,843	29,318	NA.
Other do	r1,656	2,305	NA.
Selenium, elemental[1]	r166	201	NA.
Silicon, elemental[1]	r14,573	19,928	NA.
Tin:			
Ore and concentrate	42,910	42,014	Bolivia 30,675.
Metal including alloys:			
Scrap	1,303	1,078	United States 435; Netherlands 191.
Unwrought and semimanufactures	6,293	8,070	Netherlands 2,874; Nigeria 2,137; Malaysia 1,072.
Titanium:			
Ore and concentrate[1] thousand tons	r259	381	NA.
Oxides do	2	3	West Germany 1.
Metal including alloys, all forms[1] do	r4	6	NA.
Tungsten:			
Ore and concentrate	3,355	3,829	Netherlands 780; Portugal 679; West Germany 497.
Metal including alloys, all forms	221	146	United States 72; West Germany 32.
Uranium and thorium:			
Ore and concentrate	913	NA	
Metal including alloys, all forms	4	2	NA.
Zinc:			
Ore and concentrate thousand tons	108	120	Peru 48; Canada 25.
Oxide and peroxide	1,147	2,196	NA.
Metal including alloys:			
Scrap and blue powder	1,914	875	NA.
Unwrought thousand tons	200	203	Netherlands 77; Canada 41; Finland 30.
Semimanufactures	4,333	3,916	West Germany 2,397; France 881.

See footnotes at end of table.

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Table 3.—United Kingdom: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Zirconium:[1]			
Ore and concentrate	r34,700	21,800	NA.
Metal including alloys, all forms	r900	600	NA.
Other:			
Ore and concentrate of tantalum and vanadium value, thousands	r$66,323	$27,533	Australia $8,678; Netherlands $5,336; Canada $4,586.
Ash and residue containing nonferrous metals	68,908	60,509	United States 12,742; Norway 11,167; West Germany 8,187.
Oxides, hydroxides, peroxides of metals, n.e.s	258,967	222,254	Netherlands 92,537; United States 69,840.
Metal including alloys, all forms:			
Metalloids, n.e.s. value, thousands	r$49,619	$26,731	NA.
Alkali, alkaline earth, and rare-earth metals	993	159	West Germany 132.
Pyrophoric alloys	19	39	NA.
Base metals including alloys, all forms, n.e.s	11,916	14,486	United States 3,838; Republic of South Africa 3,563.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc thousand tons	138	301	Italy 145; Greece 131.
Dust and powder of precious and semi-precious stone value, thousands	r$10,510	$5,142	NA.
Grinding and polishing wheels and stones	2,585	2,634	Netherlands 559; Italy 501; West Germany 388.
Asbestos thousand tons	139	144	Canada 98; Swaziland 18; Republic of South Africa 15.
Barite and witherite do	28	36	Ireland 19; Morocco 3.
Boron materials:			
Borax[1]	r12,300	9,400	NA.
Oxide and acid	4,034	7,211	France 3,556; Turkey 2,409; United States 1,191.
Bromine	r2,929	2,738	Netherlands 1,621; Israel 606.
Cement thousand tons	104	77	Ireland 72.
Chalk	585	374	NA.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s thousand tons	166	147	United States 74; Republic of South Africa 32.
Products:			
Refractory (including nonclay bricks)	78,487	53,100	West Germany 12,045; Ireland 7,881; France 7,747.
Nonrefractory	28,337	29,433	Italy 11,427; West Germany 5,494.
Cryolite and chiolite	2,520	2,085	Denmark 2,047.
Diamond, all grades value, millions	r$1,771	$635	NA.
Diatomite and other infusorial earth value, thousands	r$2,044	$668	United States $404; Denmark $147.
Feldspar and fluorspar thousand tons	171	172	Norway 108; Finland 35.
Fertilizer materials:			
Crude:			
Nitrogenous do	7	8	Chile 7; Netherlands 1.
Phosphatic do	1,588	1,762	Morocco 1,260; Senegal 242.
Potassic do	29	31	East Germany 21; West Germany 10.
Manufactured:			
Nitrogenous do	r258	395	NA.
Phosphatic:			
Thomas (basic) slag	33,867	17,152	Belgium-Luxembourg 16,701.
Other	25,722	32,531	Belgium-Luxembourg 15,363; France 8,491.
Potassic thousand tons	686	732	East Germany 227; West Germany 136; Israel 75.
Other including mixed do	r265	194	Netherlands 90; Belgium-Luxembourg 32.
Graphite, natural	14,008	13,973	Madagascar 6,033; Norway 3,933.
Gypsum and plasters thousand tons	88	86	Ireland 68; France 11.
Iodine	r862	949	NA.
Lime	1,413	1,086	NA.
Magnesite thousand tons	138	82	NA.
Mica:			
Crude including splittings and waste	10,286	84,505	Spain 40,070; Greece 21,099.
Worked including agglomerated splittings	319	423	Belgium-Luxembourg 260; West Germany 84.

See footnotes at end of table.

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Table 3.—United Kingdom: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Pigments, mineral:			
Natural, crude	4,085	4,863	Austria 1,685.
Iron oxides, processed	17,416	24,880	West Germany 20,526.
Precious and semiprecious stone except diamond:			
Natural value, thousands	r$73,158	$20,417	Switzerland $7,344; West Germany $3,738.
Manufactured do	r$1,119	$293	United States $145.
Pyrite (gross weight) thousand tons	28	11	Spain 8.
Salt and brine do	20	20	NA.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	47,954	21,265	West Germany 18,224; France 2,559.
Caustic potash, sodic and potassic peroxides	2,461	3,938	West Germany 739.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	13,516	13,087	Italy 12,424.
Slate	1,431	1,277	NA.
Other	16,063	12,897	Republic of South Africa 4,499; Sweden 2,816.
Worked:			
Slate	2,943	1,670	Spain 1,016.
Paving and flagstone	14,884	14,458	Portugal 14,119.
Other	16,477	13,450	Italy 8,467; India 2,296.
Dolomite, chiefly refractory grade	37,392	46,727	Spain 31,701; Norway 12,938.
Gravel and crushed rock thousand tons	431	227	Ireland 146; Norway 36; Italy 26.
Limestone (except dimension)	5,851	4,976	NA.
Quartz and quartzite	3,527	3,587	West Germany 451.
Sand excluding metal bearing thousand tons	132	157	Belgium-Luxembourg 117.
Sulfur:			
Elemental:			
Other than colloidal do	939	1,178	Poland 444; France 278; Mexico 173.
Colloidal	389	5,381	NA.
Sulfuric acid thousand tons	82	162	NA.
Talc, steatite, soapstone, pyrophyllite	58,480	61,431	Norway 16,031; France 12,985; People's Republic of China 7,999.
Other nonmetals, n.e.s.:			
Crude:			
Meerschaum, amber, jet	20,515	26,419	Spain 25,213.
Other thousand tons	296	464	Norway 160; Italy 84; United States 60.
Slag, dross and similar waste, not metal bearing:			
From iron and steel manufacture	97,083	42,566	Canada 31,248; France 6,870.
Slag and ash, n.e.s	38,579	10,632	Netherlands 8,691.
Oxides and hydroxides of magnesium, strontium, barium	31,590	31,604	Italy 21,491; Japan 7,094.
Building materials of asphalt, asbestos and fiber cement, and unfired nonmetals, n.e.s	47,657	54,484	Belgium-Luxembourg 28,935; Ireland 12,351; France 6,043.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	22,652	23,929	Trinidad and Tobago 12,717; France 8,038; United States 2,706.
Carbon black and gas carbon:			
Carbon black	7,128	13,705	United States 3,954; France 2,228; West Germany 1,562.
Gas carbon	NA	4	NA.
Coal and briquets:			
Anthracite and bituminous thousand tons	5,083	2,836	Australia 1,467; United States 750.
Briquets of anthracite and bituminous coal do	119	82	France 63; West Germany 18.
Lignite and lignite briquets	18	NA	
Coke and semicoke thousand tons	3	(2)	NA.
Hydrogen and rare gases	2,958	2,311	United States 828; Netherlands 333.
Peat including peat briquets and litter thousand tons	118	127	Ireland 114.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	611,429	r611,247	Iran 81,501; Kuwait 79,247.

See footnotes at end of table.

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Table 3.—United Kingdom: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum —Continued			
Refinery products:			
Gasoline (including natural) thousand 42-gallon barrels	r45,917	50,881	Netherlands 10,651; Italy 9,044.
Kerosine and jet fuel ____do____	r9,440	10,711	Netherlands 4,356; Italy 1,798.
Distillate fuel oil_____do____	r17,494	22,149	Belgium-Luxembourg 5,916; Netherlands 3,834; U.S.S.R. 3,380.
Residual fuel oil _____do____	r27,797	18,029	Netherlands 8,119; Belgium-Luxembourg 2,131.
Lubricants _____do____	r2,551	2,954	Netherlands Antilles 777; Netherlands 707.
Other:			
Liquefied petroleum gas _do____	r9,500	11,913	Algeria 9,164; Sweden 1,311.
Mineral jelly and wax __do____	r409	315	Netherlands 260.
Nonlubricating oils, n.e.s do____	r133	133	United States 42; West Germany 35; Belgium-Luxembourg 28.
Bitumen and other residues and bituminous mixtures, n.e.s. do____	r1,309	945	United States 436; Belgium-Luxembourg 182.
Pitch, pitch coke, petroleum coke do____	r1,386	1,315	United States 792; Netherlands 253.
Total _____do____	r115,936	119,345	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals _____	225,632	260,906	Netherlands 151,477; France 55,738.

rRevised. NA Not available.
[1]Source: Institute of Geological Sciences, United Kingdom Mineral Statistics, 1977. London.
[2]Less than 1/2 unit.

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Table 4.—United Kingdom: Mineral trade with the United States, 1976[1]

Commodity	Exports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Aluminum metal including alloys	6,105	$7,730	26,109	$42,638
Bauxite and alumina	--	--	1,032	145
Copper:				
Metal including alloys	11,693	18,875	19,663	32,636
Ore and concentrate	--	--	179	154
Iron and steel:				
Ore and concentrate	NA	1	30	32
Metal:				
Scrap	254	705	466,465	46,365
Pig iron	8,250	1,106	12,462	2,062
Ferroalloys	575	2,293	781	520
Steel, primary forms	43,343	13,154	442	434
Semimanufactures:				
Bars and angles	281,411	76,004	1,430	2,501
Plates and sheets	74,096	24,691	43,351	17,957
Hoop and strip	4,324	6,266	4,898	3,907
Rails	1,559	639	1	7
Wire	28,390	17,538	346	790
Tubes and pipes	36,461	24,315	19,463	33,013
Castings and forgings	3,168	2,980	4,774	6,265
Lead:				
Metal including alloys	1,897	2,392	101	209
Ore and concentrate	--	1,091	260	
Molybdenum ore and concentrate	--	--	497	2,702
Nickel:				
Metal including alloys	1,014	5,736	1,621	14,099
Ore and concentrate	20	48	--	--
Platinum-group metals and silver:				
Ores	5	1,119	1,014	21,838
Metals:				
Platinum group	16	50,181	1	1,595
Silver metal including alloys	204	28,651	401	7,270
Radioactive and associated materials	5,085	180,999	505	26,975
Tin metal including alloys	572	3,650	215	454
Uranium metal including alloys	--	--	NA	3
Uranium and thorium concentrates	--	--	584	18,541
Zinc metal including alloys	1,984	1,611	181	321
Other nonferrous metals:				
Ores and concentrates, n.e.s.	21	76	2,520	2,789
Metals:				
Base metals including alloys, n.e.s	2,699	12,139	3,957	17,134
Scrap	2,670	3,139	15,404	14,527
NONMETALS				
Abrasives, natural, including diamond	1,168	1,955	14,113	6,017
Asbestos, all forms	515	282	1,038	230
Cement	82,230	1,632	393	121
Clays and refractory materials	23,189	1,285	85,382	6,497
Diamond and precious stones:				
Industrial diamond	NA	3,559	NA	209
Gem diamond and precious stones	2	121,048	19	5,881
Fertilizer materials:				
Crude, phosphatic	--	--	164,410	5,416
Manufactured, potash	1	1	18,130	919
Potassium nitrate, crude	--	--	186	7
Other	--	--	480	26
Lime	--	--	122	9
Ammonia, anhydrous	--	--	42,638	3,411
Oxygen, nitrogen, rare gases	--	--	1,251	2,265
Quartz, mica, feldspar, etc	150	45	127	326
Salt, sodium chloride	21,797	68	158	72
Stone, sand and gravel:				
Dimension stone	311	154	78	58
Crushed and broken stone, sand and gravel	2,208	155	3,190	841
Sulfur:				
Sulfur and unroasted pyrites	--	--	139	33
Sulfuric acid	(2)	(2)	5	1
Other:				
Crude	3,447	1,268	2,652	1,062
Slag, dross and similar waste	--	--	686	255
MINERAL FUELS AND RELATED MATERIALS				
Asphalt, natural	--	--	4,185	697
Coal, all types	NA	2	773,591	46,951
Coke	--	--	120	17
Gas, natural and manufactured	14,997	1,459	738	17
Petroleum:				
Crude and partly refined	636,534	63,194	--	--
Refinery products:				
Gasoline	20,633	3,250	42	38

See footnotes at end of table.

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Table 4.—United Kingdom: Mineral trade with the United States, 1976[1] —Continued

Commodity	Exports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
MINERAL FUELS AND RELATED MATERIALS —Continued				
Petroleum —Continued				
Refinery products —Continued				
Jet fuel	--	--	85	$6
Distillate fuel oil	45	$2	--	--
Residual fuel oil	861,652	60,602	49	5
Lubricants	3,643	899	66,059	14,854
Petroleum jelly and mineral waxes	24	23	2,299	1,082
Total	XX	746,921	XX	415,466

NA Not available. XX Not applicable.
[1]Data may differ from those reported elsewhere in this chapter owing to a difference in source.
[2]Less than 1/2 unit.

Source: U.S. Department of Commerce, Bureau of the Census.

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COMMODITY REVIEW

METALS

Aluminum.—Production increased somewhat over 1976, but demand slackened in the latter half of the year and stocks increased.

Three large smelters comprised the United Kingdom's aluminum industry: The Anglesey plant of Kaiser Aluminum & Chemical Corp. (67%) and Rio Tinto-Zinc Corp. Ltd. (RTC) (33%), with nominal capacity of 100,000 tons of virgin aluminum per year; the Lynemouth, Northumberland, plant of Alcan Aluminium Ltd. (100%), capacity 120,000 tons annually; and the Invergordon, Scotland, plant of the British Aluminium Co. Ltd., with capacity of 100,000 tons per year. British Aluminium also operated two smaller plants at Kinlochleven (10,000 tons) and Fort William (30,000 tons) both in Scotland.

The Anglesey plant of Kaiser-RTZ, at Holyhead, operated above its nominal 100,000-ton capacity during the year, signifying an end to the operating difficulties that had plagued most of its 7-year life.

There was no production of bauxite in the United Kingdom. Alumina for the operating plants was imported from Jamaica and Australia. Some alumina was also produced from imported bauxite at the Burntisland plant of British Aluminium near Edinburgh, which had a capacity of 125,000 tons of product per year.

Copper.—Imperial Chemical Industries (ICI) decided to sell to the public the 63% of Imperial Metal Industries Ltd. (IMI) that it held; this amounted to 130.9 million shares valued at about £65 million.[3] IMI controlled IMI Refiners Ltd. which operated the copper refinery at Walsall, near Birmingham.

Iron and Steel.—In 1977, the 10th anniversary year of nationalization of the steel industry, the British Steel Corp. (BSC), successor of 14 large private companies, was facing severe difficulties. After moderate profitability in the late 1960's and early 1970's, a loss of $446 million was suffered in the year to March 1976, a loss of $165 million in the following year, and in the year to March 1978, the financial hemorrhage was expected to approach $1 billion.

The year started with a moderate increase in orders, but by summer it became clear that the worldwide steel recession was persisting, especially in Europe. BSC depended upon the export market for about 3 million tons annually out of its production of under 20 million tons, and it was hoped to increase this to 6 million tons annually, but the chance of reaching this goal disappeared as world steel markets were increasingly characterized by depressed demand, excess capacity, and extreme price competitiveness.

BSC's difficulties essentially related to "overstaffing," or surplus employees, which any nationalized industry would find difficult to correct, and to inefficient plants, which have not been modernized as fast as those of competitor countries. Internal rigidity and management problems were also reported to be contributing factors. A few facts highlight the situation: Capacity utilization was 60% to 65%, compared with an excessively high breakeven point of 90%; employment, at about 205,000, was 60,000 in excess of that needed; productivity in terms of steel production per work-hour was 40% that of Japan, 49% of that of the United States, and 61% of that of France; and steel imports had increased from 10% to 40% of consumption in the 10 years since nationalization.

In 1977, the BSC was midway in the ambitious program of expansion and modernization begun in 1973-74, that has required substantial borrowing from both private and public sources. The original strategy aimed at producing at least 35 million tons of steel annually in the early 1980's, of which 20% would be exported. It was becoming increasingly clear that exports could not reach this figure, and that in the competitive market actual exports would hardly be profitable, thus calling the whole expansion strategy into question.

During the year the BSC reached the borrowing limits allowed to it in the private market and was forced to rely exclusively on Government funds. It was predicted that Government support of the expected magnitude would require 6% to 7% of the whole public sector borrowing during the fiscal

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year to March 1978, and BSC's chairman stated publicly that the corporation would be in receivership if it had been a private sector company. Support on such a level left the BSC vulnerable to charges of subsidies by other European Community nations, although many other countries' producers also received some form of Government aid. It also left the BSC open to possible dumping complaints and countervailing duties in the United States.

Four possible options seemed open to the British Government to meet the problem of BSC's losses: To cut back on the massive ongoing modernization program; capital restructuring of BSC, that is, a Government writeoff of BSC's capital; a reduction of employees; and rapid closure of inefficient plants. A House of Commons Select Committee was to complete recommendations on these and other points early in 1978.

BSC produced about 85% of domestic steel in 1977; the private sector, located largely in the Midlands and based on scrap melting, produced about 15%, or some 3 million tons of crude steel. In some products, such as bright bars, cold rolled strip, forgings, tubes, and pipes, the private sector's contribution was between 60% and 99%. Deliveries of finished steel by the 120 companies in the private sector were also high, being approximately 6.5 million tons; in contrast to BSC, private sector companies avoided losses, although encountering stiff import competition.

One new steel plant was opened by the private sector during the year. The Alphasteel project in Newport, South Wales, was commissioned by Halyvourghiki S.A., the Greek steelmaking firm, with the start in July of the first of four electric furnaces. The production target for 1978 was around 800,000 tons of raw steel, and about 650,000 tons of finished products, including about 250,000 tons of plates, 250,000 tons of sheet in coil, and 150,000 tons of hot strip and tube strip.

The £90 million scheme to produce reduced iron by direct reduction with North Sea gas of imported ore, largely from the Republic of South Africa, was abandoned by the North Sea Iron Co., a consortium of multinational partners (not BSC as originally reported). Consolidated Gold Fields Ltd., the largest partner, attributed the action to the continued depression in the steel industry. The capacity of the project, to have been located at Jarrow, near Newcastle, would have been at 800,000 tons annually, making it the world's largest direct reduction plant using the Thyssen Purofer process.

Lead and Zinc.—Force Crag Mines (UK) Ltd., controlled by New Force Crag Mines Ltd. of Toronto, started exploration and development work on its Force Crag mine at Braithwaite, west of Keswick, Cumbria, late in the year. Early in 1978, planning permission was granted by the local authority, the Special Planning Board of the Lake District. It was hoped to start operations by the end of 1978.

One primary lead-zinc smelter operated during the year; this was the Imperial Smelting Furnace of Commonwealth Smelting Ltd. at Avonmouth, near Bristol, which had a design capacity of 90,000 tons of zinc and 40,000 tons of lead annually. In addition, a lead refinery at Northfleet, east of London, operated by Britannia Lead Co. Ltd., had a capacity of about 150,000 tons of refined lead per year from ore originating at the Mt. Isa mine in Australia.

Tin.—The Cornish tin mines were buoyed up during the year by favorable tin prices and continued investment in additional facilities.

The Mount Wellington mine of Cornwall Tin & Mining Ltd., encountered severe water influx problems, at times reaching 5,000 gallons per minute, and installed new pumps with a calculated excess capacity; a crosscut was also driven to the shaft of the inoperative United mine to lower the water level and assist in drainage.

The Wheal Jane mine of Consolidated Gold Fields Ltd., also a neighbor of Mount Wellington, carried on a £4 million development program, including deepening the mine shaft, new hoisting and pumping facilities, and the use of a raise borer in development. The new stopping area of the mine was found to be high in zinc. Copper was also present, and a new section was added to the concentrator to produce copper and zinc concentrates. Plans for the future included mining of 200,000 tons of ore per year to produce concentrates containing 1,000 tons of tin, 400 tons of copper, 6,000 tons of zinc, and 80,000 ounces of silver annually. Tin concentrate was sent to the Copper Pass smelter in East Yorkshire, copper concentrate to Boliden A.B. in Sweden, and zinc concentrate to smelters in Belgium. Apart from its Wheal Jane mine, Consolidated Gold Fields was investigating two other potential tin areas; Porkellis Moor, between Camborne and Helston; and Red Moor, between St. Austell and Bodmin, where tin

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mining has never been carried out.

St. Piran Ltd., a parent company of South Crofty Ltd. (largest United Kingdom tin mine), sold 35% of the subsidiary's capital to the public; it was heavily oversubscribed. St. Piran also operated the smaller Pendarves tin mine and was investigating the possibility of reopening the old Lambriggan lead-zinc mine between Truro and Perranporth.

The fourth of the major tin producers, Geevor Tin Mines Ltd., at Pendeen, near St. Just, allocated additional capital to continue its subincline project, which was to provide access to additional ore reserves lying offshore.

Tungsten.—The tungsten-tin prospect at Hemerdon, near Plymouth, owned by Hemerdon Mining and Smelting Ltd. of Bermuda, was the object of a joint venture entered into between Hemerdon and Amax Exploration Inc. of the United Kingdom. Under the agreement Amax had the option of acquiring a half share in the ore body in return for completing an agreed program of work and paying Hemerdon an undisclosed sum of money. Hemerdon had earlier completed the first phase of exploration at the property by drilling a total of 3,600 feet in 45 holes, confirming estimates that the ore body contained reserves of some 5.6 million short tons assaying 3.6 pounds of tungsten per short ton and 1 pound of tin per short ton. In the second phase, before deciding to proceed, Amax was to drill an additional 4,000 to 6,000 feet to depths of 400 to 500 feet; this would be followed, in a third phase, by an additional 9,000 feet of drilling and pilot-processing plant work.

St. Piran Ltd., the Cornish tin producer, received permission to conduct drilling at the former wolframite deposit at Castle an Dinas, north of St. Austell in Cornwall, last worked in 1956; it was hoped that the lode, averaging 0.5% to 2.5% WO_3, extends north from the worked part of the mine.

NONMETALS

Cement.—Some 31 cement plants operating in the United Kingdom in 1977 had a total kiln capacity of 19,192,000 tons at yearend. Associated Portland Cement Manufacturers Ltd., was the largest producer, with a total kiln capacity of 11,492,000 tons in 16 plants, the largest of which was the 4-million-ton plant at Northfleet, Kent, east of London. A total of seven companies, including Associated, manufactured cement in the United Kingdom.

Clays.—After 7 years of environmental opposition, ECC Ball Clays, a subsidiary of English China Clays Ltd., won the right from the Secretary of State for the Environment for the winning and working of ball clays on the Arne Peninsula of Dorset, west of Bournemouth. ECC will exploit an area of 44 acres subject to stringent conditions.

Fertilizer Materials.—*Nitrogen.*—Shellstar Ltd. (UKF Fertilizers), controlled by DSM of the Netherlands, was granted planning permission for the construction of an ammonia plant at Ince Marshes, across the Mersey River from Liverpool. If the company decided to go ahead, this would be the second plant at the site and would boost capacity by 272,000 tons per year of ammonia to over 500,000 tons.

After several years of delays, the Scanitro ammonia project at Peterhead, Scotland, was abandoned, at least for the foreseeable future, by its sponsors, Norsk Hydro AS of Norway and Supra AB of Sweden; the depressed market was given as the reason. The plant was to have produced 360,000 tons per year of ammonia with natural gas from the Anglo-Norwegian Frigg field in the North Sea.

ICI Ltd., the dominant British producer of ammonia with 80% of British capacity, reached a settlement with British Gas Corp. for continued supplies of natural gas at 6 to 7 pence per therm (100,000 Btu's), double the earlier long-term contract price. This would make it easier for Shellstar (18% domestic capacity) and Nitrogas Fertilizers Ltd. (2%) to compete, because they also were paying the higher price.

Potash.—The trouble-plagued Cleveland Potash Ltd. mine at Boulby, in the North Yorkshire Moors National Park, was advanced a further £20 million, bringing total spending on the project by the parent companies, Charter Consolidated Ltd. and ICI Ltd., to £105 million, about four times the original estimate. The money was to be used to develop more working areas underground. The rate of production did not reach 25% of capacity (which was nominally 1 million tons of product) by yearend, but there was nevertheless a continued improvement. Continuous miners were introduced, a new method of drilling ahead of the face was instituted, and water spray coolers were installed to reduce the high temperatures underground. But then the operation received yet another blow when dangerous quantities of gas were found associated with shale horizons in the potash seam, and one

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miner was killed in a related explosion.

After taking over Whitby Potash Ltd. early in the year from Shell Petroleum, Consolidated Gold Fields Ltd. appealed against refusal of the National Park Committee to extend planning permission for a potash mine near Cleveland. Local government agencies supported Gold Fields' plans to produce 450,000 tons per year of KCl and 500,000 tons per year of common salt (NaCl) by solution mining, followed by precipitation of the salts in a refinery to be built at Stainsacre, just southeast of Whitby and some 4 miles southeast of the minefield pumphouses.

Fluorspar.—The Hopton, Derbyshire, flotation plant southwest of Matlock, which was shut down in 1976 by the former operators (the Giulini group) was purchased for £1,425,000 by Dresser Minerals International. Dresser started to reequip the plant to handle 1,000 tons per day of ore (equivalent to about 80,000 to 100,000 tons per year of acid-grade fluorspar product) and expected to commence production in the second quarter of 1978. The plant, which was renamed the Ryder Point plant, has facilities to recover barite and lead-zinc concentrates. Dresser also acquired mining rights to over 10,000 acres of land in areas close to the plant.

The largest United Kingdom producer of fluorspar was Laporte Industries Ltd. at Stoney Middleton (Blakedon), also in Derbyshire, where both acid and metallurgical fluorspar were produced in the central Cavendish mill. The company consumed much of the acid fluorspar in its own hydrofluoric acid plant at Rotherham. Swiss Aluminium Mining (UK) Ltd. (SAMUK) purchased the 20,000-ton-per-annum acidspar Weardale plant of ICI Ltd., during 1977; the plant is located at Rookhope, County Durham. SAMUK was also continuing construction on the 60,000 to 70,000-ton-per-year processing plant at Broadwood Quarry, Frosterley, County Durham, scheduled for completion in January 1979.

The other large producer in County Durham was the BSC, which operated the Blackdene, Groverake, and Whiteheaps mines, as well as the Beaumont mine at Allenheads, Northumberland, all of which produce metallurgical-grade fluorspar A new 70,000-ton-per-year briquetting plant was under construction at Blackdene, with completion scheduled for mid-1979.

In addition to the four large fluorspar producers, there were at least six smaller producers near Laporte in Derbyshire and two small producers in Yorkshire.

MINERAL FUELS

The United Kingdom was becoming less dependent on imported fuels, in spite of a lackluster performance in 1977 by the coal mining industry. By yearend, the petroleum production of the North Sea reached half the domestic consumption, or almost a quarter of total energy consumption. A summary of the supply and consumption pattern is given in table 5.

Table 5.—United Kingdom: Supply and apparent consumption of fuels and power

(Million tons of standard coal equivalent[1])

	Total primary energy	Coal and coke	Petroleum and refinery products	Natural gas	Hydro electric and nuclear power
1975:					
Production	171.8	110.6	2.3	46.0	12.9
Imports[2]	164.7	4.5	159.1	1.1	--
Exports[2]	39.5	[3]11.8	[3]27.7	--	--
Apparent consumption	297.0	103.3	[4]133.7	47.1	12.9
1976:					
Production	187.6	106.2	17.7	48.8	14.9
Imports[2]	156.9	2.8	152.8	1.3	--
Exports[2]	39.6	[3]4.3	[3]35.3	--	--
Apparent consumption	304.9	104.7	[4]135.2	50.1	14.9

[1]1 ton standard coal equivalent = 7,000,000 kilocalories.
[2]Includes stock change.
[3]Includes bunkers.
[4]Includes refinery fuel and losses.

Source: International Energy Agency, Organization for Economic Cooperation and Development. Energy Balances of OECD Countries, 1974/1976, Paris, 1978.

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Coal.—The estimated 1977 coal output was about 118 million tons, the lowest post-World War II level, except in major strike years. Reversal of the continuing decline was proving difficult but was seen to depend largely upon productivity, available work force, and environmental constraints, and to a much lesser extent on availability of capital. In the post-war era, coal had been displaced so thoroughly by Middle East oil that even in the 1970's, and following the oil crisis, output and productivity failed to increase. In spite of the unsatisfactory production record, a somewhat anomalous financial surplus of £27 million was recorded in the year to March 1977, after a smaller surplus in the preceding year.

It had become apparent in recent years that the original Plan for Coal, which called for production of 135 million tons by 1985, was too optimistic and during 1976 a target of 120 million tons, just barely maintaining capacity, was adopted. By 1977 the planning figure generally accepted was 170 million tons by the end of the millenium, for an expenditure of £3,700 million.

This figure was to be reached by development of two major new coal mining areas: Selby, in Yorkshire, now expected to cost £400 million and produce 10 million tons annually by 1985-86; and the Vale of Belvoir, an area in North Leicestershire where three mines were to be developed at Hose, Ashfordby, and Saltby, to yield some 7 million annual tons, at a development cost of around £500 million.

While Selby was proceeding on schedule, various obstacles were hindering progress on the Vale of Belvoir mines. Opposition on environmental grounds was strong, not only against the coal industry in general, but also because of the rural nature of the Vale, which residents feared would be destroyed by coal mining. A further argument was advanced on economic grounds; in the near future prospects for increased coal usage were not bright, in either steel or electricity generation, because of reduced energy demand compared with the high demand of a few years earlier, and coal from the Vale might not be needed.

Other areas came in for a share of attention as well. Drilling for oil in the North Sea had revealed large reserves of exploitable coal in seams averaging 3 to 14 feet and reaching as much as 50 feet in thickness. According to the Department of Energy, these reserves, lying at 5,000 to 11,000 feet below the seabed, which itself was several hundred feet below the surface, could probably be exploited only by in situ gasification. In the Forest of Dean, Gloucestershire, 0.5 million tons of coal could be mined when a fortuitous storm destroyed the scenic forest cover. The National Coal Board (NCB) also was empowered by passage of the Coal Industry Act by Parliament to take part in overseas mining projects; in a venture with Australian interests, the NCB won exploration rights for a 200-million-ton coalfield near German Creek, Queensland, which would produce 3 million tons per year by 1981.

All coal in the United Kingdom was produced by the NCB, a nationalized company organized into 12 semiautonomous areas (plus a small independent field in Kent); everyday operations, negotiations with labor unions, and lesser capital expenditures were controlled by the Area Director. There were 243 "deep mine" units in these areas, employing 240,000 workers and producing 110 million tons of coal. In addition, a number of opencast mines were operated by private contractors.

Natural Gas.—Late in the year the first gas from the northern basin of the North Sea, where it is largely associated with oil, was delivered by pipeline from the Anglo-Norwegian Frigg field to St. Fergus near Peterhead, Scotland. A second pipeline from Frigg to St. Fergus was to be ready in 1978 to deliver gas from the Norwegian installations in the field. Some 700 miles of high-pressure pipe had been laid through Scotland and northern England to connect the St. Fergus terminal to the national gas transmission system. Frigg gas was expected to cost twice as much as gas from the southern North Sea basin.

A consultative group, Gas Gathering Pipelines (North Sea) Ltd., was formed by British Gas (the sole distributor of gas), British National Oil Corp., and five private companies, (British Petroleum Co. Ltd., ICI, RTZ, and France's Total and Elf) to study pipeline options for gathering gas from a number of fields in the northern North Sea. A report by Williams Merz, Consulting Engineers, which was commissioned by the United Kingdom Department of Energy, was to be considered. The group was to submit an initial report by yearend and a final report by March 31, 1978. Among the options available was a first stage linking of the Thistle, Murchison, and Ninian fields in the north to the Brent system, and linking the more southerly fields in the northern

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basin, Piper and Tartan, to the Frigg system.

About 97% of the gas supplied in Great Britain came from the southern basin of the North Sea. The Frigg field and nearby fields will lower this figure. Production at the Hewitt field, one of the most important in the southern field, also passed its peak and started to decline after being in operation since 1969, but two nearby reservoirs were to offset this to some extent.

Petroleum.—After 2 years of steadily growing production, the United Kingdom's output, mostly from North Sea fields, was about 1 million barrels per day at yearend, equivalent to half of the consumption. The 1977 total was about 38 million tons (279 million barrels). In October, the Claymore field became the eighth field (out of 14 declared commercial) to come into production, and at that time the fields in the United Kingdom sector were as follows:

Field name	Major ownership (percent)	Date of startup	Estimated recoverable reserves (million tons)
Argyll	Hamilton Bros. (36). RTZ Texaco (24)	June 1975	22
Forties	BP (96) Shell/Esso (4)	November 1975.	240
Auk	Shell (50) Esso (50)	February 1976.	8
Beryl	Mobil (50) Amerada (20) Texaco Eastern (20).	June 1976	70
Montrose	Amoco (30.77) British Gas (30.77). Amerada (23.08) Texas Eastern (15.38).	June 1976	20
Brent	Shell (50) Esso (50)	November 1976.	230
Piper	Occidental (36.5) Getty (23.5) Allied Chemical (20). Thomson (20)	December 1976.	95
Claymore	Occidental (36.5) Getty (23.5) Allied Chemical (20). Thomson (20)	October 1977	57

The Thistle field, operated by the British National Oil Co. (BNOC) for an eight-member consortium, did not reach production as scheduled because of holdups in construction.

Decisions to develop several fields were made during the year. BP decided to develop the small Buchan field, 100 miles east of Aberdeen, 1 month after buying a 54.16% majority stake in the consortium; reserves were estimated at between 115 and 250 million barrels. Output will be between 50,000 and 100,000 barrels per day, starting hopefully late in 1978. BP also decided to go ahead with the Magnus field for production in the early 1980's. Reserves were put at 400 million barrels. Pan Ocean Oil Corp., a subsidiary of Marathon Oil Co., signed a participation agreement with the British Government under which the BNOC will be entitled to 51% of the production if the Brae field is found to be commercial. Reserves at Brae were estimated roughly between 200 and 700 million barrels.

Texaco Ltd. announced plans to begin producing oil in the Tartan field, 115 miles northeast of Aberdeen, in late 1979 or early 1980; capacity will be about 75,000 barrels per day of oil and 12,000 barrels per day of natural gas liquids, plus natural gas.

The Beatrice field (block 1-30), located in shallow water 12 miles offshore in the Moray Firth, was to be developed through offshore loading, without a pipeline, by the operator, the Mesa Petroleum Group, if approval was obtained from the Department of Energy. An early estimate of reserves was 400 million barrels.

Discovery of a new field, named Fulmar, was announced by Shell and the Esso subsidiary of Exxon. The field was located in relatively shallow water about 170 miles east of Dundee, Scotland, in the center of the British North Sea fields. The field is near the Auk field, but in a different formation, and reserves were thought to be larger. Production startup was slated for 1981, and production could reach 150,000 barrels per day, depending on the size of the reserves.

Onshore, an apparently commercially viable oilfield was discovered late in the year by British Gas/BP at Wytch Farm, near Corfe Castle, Dorset, on the south coast. Early estimates put recoverable reserves at

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50 million barrels; peak production of about 10,000 barrels per day would be reached in 1979. This would make it the largest onshore field in the United Kingdom and larger than the smallest North Sea fields now in production. A second oil-bearing reservoir was also discovered below the first Wytch Farm field.

Increased attention was given during the year to the West Shetland basin, west of the Shetland Islands, following a strike of heavy crude by BP in block 206-8, in 435 feet of water about 45 miles west of the oil terminal at Sullom Voe in Shetland. Sedimentary structures in the area are known to be large but are apparently thin. Late in the year Texaco was reported to have found oil in the area, and just after yearend a noncommercial oil and gas find was made by a consortium led by the Elf Co. of France. Activity was stimulated because licenses in the area had to be relinquished in the spring of 1978.

In the Fifth Round of oil-concession awards, and the first since 1972, the Government conditionally gave licenses to 65 companies to explore for and produce petroleum and natural gas on about 9,000 square kilometers of offshore tracts in 44 blocks in the North Sea, Irish Sea, Cardigan Bay, English Channel, and west of Scotland. The licenses were conditional upon the companies reaching operating agreements with BNOC. The largest awards went to BP, almost 69% owned by the British Government, which received 13 blocks. Other large recipients of conditional licenses were Texaco, Inc., and the Royal Dutch-Shell group.

Noteworthy was the requirement in the licenses that the BNOC be a 51% partner in the leases. BNOC, the agency organized early in 1976 through which the Government intended to play an active part in offshore oil production, obtained a loan for $825 million from a group of U.S. and British banks to finance its prospecting and development of North Sea oil and to redeem some of its initial debt to the British Treasury; the BNOC operated as a private concern and held between 12% and 33.3% interest in five major North Sea fields, in addition to its prospective share of 51% of Fifth Round fields.

Proposals for new terms and conditions for onshore petroleum production licenses were published on December 15. They included provision for 51% State participation and royalties reaching 12.5% on production over 200,000 tons (1.4 million barrels) per year. In 1977, there existed 53 onshore production licenses covering 7,151 square kilometers, most issued between 1966-72; production onshore was about 700,000 barrels in the year.

Agreement was reached with France on the location of the national boundary line in the English Channel and the Western Approaches when both parties accepted the decision of an international arbitration court in Geneva. The decision gave an approximately equal share of the disputed 40,000 square miles to each country, but full effect was not given to the Scilly Isles and the Channel Islands. The British Government later decided to question the boundary line on the grounds that the cartographer had drawn part of it about 4 miles too far north.

Despite surplus capacity already existant in the United Kingdom and in the European Community (EC) as a whole (overall European refinery utilization was about 60% in 1977, and in the United Kingdom it was between 60% and 70%), oil refinery expansion continued. Reasons for the expansion were to be found in the desire of the British Government not to export more than one-third of North Sea oil as crude in order to provide employment and increase the value of exports; and, in the case of certain expansions, to adapt capacity to market needs, which were shifting towards the lighter end of the barrel, that is, gasoline and distillate fuel oils.

Approval of the national Government, although not always of the local authorities, was obtained during the year for a number of projects. Occidental Petroleum Co. revived its plans for a 120,000-barrel-per-day complex at Canvey Island in the Thames estuary, costs for which are likely to exceed £200 million; Texaco and Gulf were to construct a 70,000-barrel-per-day catalytic cracking unit at Milford Haven, Wales, to service the existing refinery capacity of both companies in the area; Esso and Shell were planning similar units with capacities ranging from 20,000 to 30,000 barrels per day; and Burmah Oil and Total were studying plans for a joint 120,000-barrel-per-day refinery in Kent, along the Thames estuary, that would emphasize production of lighter products. These actions were taken despite suggestions by other members of the EC that decisions about capacity be coordinated with them.

As of yearend, there were 19 refineries operating in the United Kingdom with a

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total crude capacity of 2.91 million barrels per day. The three largest refining companies were: Shell, with four refineries (one small) and a total capacity of 690,000 barrels per day; Esso, with 657,000 barrels per day in two refineries; and BP, with 541,000 barrels per day in four refineries.

[1]Supervisory physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from British pounds (£) to U.S. dollars at the rate of £1 = US$1.75.

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The Mineral Industry of Venezuela

By Doris M. Hyde[1]

Vertical development and diversification continued to characterize the strategy and emphasis of the overall plan for growth for Venezuela's mineral and related industries. Despite the downward trend in crude oil production and export volumes, petroleum remained the major single contributor to the economy. In 1977, petroleum export sales amounted to $9.2 billion,[2] or 94% of total export earnings. The petroleum industry was estimated to have accounted for 28% of the gross domestic product (GDP) and 73% of total Government revenues, excluding borrowings. Venezuela's ambitious fifth national plan (1976-80) relied heavily on petroleum-generated revenues to provide funds for infrastructure and basic mineral industry development and expansion programs.

The coal-mining industry, still in an early stage of development, has yet to establish uncontested coking properties of various coals, as it must to qualify as an integral part of Venezuela's expanding steel industry. The fortuitous discovery of large bauxite reserves will complement the new alumina plant and enable Venezuela to develop a fully self-sufficient aluminum industry. Eventually, cessation or very substantial reductions in bauxite and alumina imports will aid the troublesome foreign trade imbalance, probably somewhat to the detriment of current supplying countries, which have generally been suffering the consequences of a depressed market, increased competition, and their own foreign trade deficits. The domestic aluminum industry should protect Venezuela from the marketing problems experienced by other countries producing bauxite and alumina.

In late 1976, Andean Pact members established a new investment code in response to pressures from those members that had determined they needed to attract additional foreign capital. Significant changes included increases in the profit and dividend remittance ceilings and the ceiling on automatic reinvestment of profits. Also, the new code permitted foreign investment in national firms, provided that the company's capital was increased and that it maintained a national or mixed status. This was an important change because such investment was previously permitted only if the company remained national.

During 1977, Venezuela, apparently guided by the new Andean Pact Decisions, initiated legislative changes that may signal a slightly more open attitude toward foreign investment. These policy modifications have not altered Venezuela's basic attitude of favoring a complementary rather than competitive role for foreign investment. The Government's less restrictive position was evidenced by the announcement that private capital participation—including foreign—was being sought for the country's second integrated steel complex, Siderúrgica del Zulia.

Changes in some provisions of the Mining Law of December 28, 1944, were made early in 1977. These changes affected the requirements for obtaining concessions for exploration and subsequent exploitation, and increased the discretionary power of Government authorities in granting these concessions. Foreign capital was not barred, although it remained subject to the established foreign investment laws.

Government Policies and Programs.—The first official Venezuelan reaction to the modified Andean Pact foreign investment

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code came in June 1977 when the Venezuelan Congress approved, but did not formally ratify, Andean Pact Decision 103. Prior to this, in February, Venezuela issued Decree 2031 modifying the regulations of Decree 62 which defined the economic sectors reserved for national control and required affected foreign companies to convert to national ownership. The new Decree extended the deadline from May 1977 to December 1977 for establishment of an 80% Venezuelan interest in certain foreign-owned companies. Additional extensions could be obtained by written application to the Superintendencia de Inversiones Extranjeras (SIEX). The Decree provided for various exemptions from this transformation to majority Venezuelan ownership, primarily in the domestic marketing sector. Foreign participation, limited to a maximum of 49%, would now be accepted in engineering design and consulting firms previously restricted to national ownership. The latter change indicated a sensitivity to the need for additional technical skill to support planned industrial expansion and development.

In December 1977, Decree 2442, Regulations for the Treatment of Foreign Capital, was announced as the replacement for Decree 63, incorporating many of the provisions of Andean Pact Decisions 103 and 109. One of the major changes followed Decision 103 and increased the ceiling on automatic reinvestment of profits for foreign companies, including the mineral extraction and processing industries, from 5% to up to 7% of invested capital, and increased the ceiling for profits remitted abroad from 14% to 20% of invested capital. Decree 2442 also clarified procedures for using any excess profits and provided means for their local reinvestment or use by the company for local operating capital; consequent interest and dividends were not considered part of the 20% limit imposed on profits remitted abroad. In addition, the Decree allowed some exceptions to the 20% profit remittance, especially concerning new economic activities related to national development priorities. Another concession to foreign investors was that SIEX could authorize technology contracts for periods of up to 15 years instead of the 5 years allowed by Decree 746. Royalty payments between the parent company and affiliates can now be made provided that the majority foreign-owned subsidiaries have signed transformation agreements with SIEX.

Through the years, various changes have been made in the Mining Law of December 28, 1944. The most recent change came in February 1977 with the issuance of Presidential Decree 2039, which declared all of Venezuela to be a reserve zone with respect to exploration for and exploitation of all minerals not otherwise provided for in the Mining Law or included in reserve zones by regulations of the Ministry of Energy and Mines (formerly the Ministry of Mines and Hydrocarbons) or other Presidential decrees. The new Decree also outlined certain factors to be considered in awarding future mineral concessions, including the technical and economic capabilities of the applicant; the applicant's willingness to manufacture or refine the mineral within the country; agreement to a tax regime acceptable to the tax authorities; provision of technology to the mining industry and its transfer to the country; acceptance of the obligation that upon extinction of the concession, regardless of reason, the assets involved will revert to the nation; and acceptance of any other special provisions considered convenient to the protection of the national mining industry. The new Decree did not distinguish between Venezuelan and foreign nationals, although the regulations and restrictions regarding hydrocarbons and iron ore remained in effect. The Ministry of Energy and Mines has yet to issue a resolution clarifying the Decree and establishing implementation procedures.

PRODUCTION

Petroleum and iron ore production remained the major contributors to Venezuela's 1977 mineral industry. Crude oil production was down slightly from that of 1976, with an average of 2.2 million barrels per day. Natural gas liquids production declined 2% to about 78,425 barrels per day. Natural gas production, almost all of which is associated, increased slightly.

Total light- and medium-gravity oil production dropped 7% from revised 1976 levels, while production of heavy-gravity oil increased 9%. Venezuela's oil development plans were designed to stop—if not reverse—this trend toward increased heavy oil production once satisfactory progress is made in the exploration and development operations of Petróleos de Venezuela S.A.

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(PDVSA, popularly known as PETROVEN).

The general worldwide recession in the steel market that began in 1975 continued to be reflected in Venezuela's declining iron ore production. Other sectors of the country's mineral industry exhibited a mixed performance during 1977 and had no noticeable effect on the total economy.

Table 1.—Venezuela: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Aluminum, unalloyed ingot	49,700	46,500	43,400
Gold, mine output, metal content troy ounces	18,326	16,506	17,490
Iron and steel:			
Ore and concentrate thousand tons	24,772	18,685	14,400
Metal:			
Pig iron do	535	422	506
Ferroalloys do	2	3	e3
Steel ingots and castings do	1,061	937	881
Semimanufactures do	r1,013	1,174	1,171
NONMETALS			
Cement, hydraulic do	3,497	3,538	3,136
Clays:			
Kaolin	15,000	7,821	10,000
Other thousand tons	1,972	2,273	2,450
Diamond:			
Gem carats	238,691	195,700	330,700
Industrial do	821,341	653,900	379,300
Total do	1,060,032	849,600	710,000
Feldspar	20,000	65,608	26,020
Fertilizer materials:			
Crude: Phosphate rock, marketable	r116,416	76,756	139,100
Manufactured:			
Nitrogenous, N content[e 2]	50,000	75,000	NA
Phosphatic, gross weight	146,252	52,739	119,255
Mixed, gross weight	80,131	93,935	78,322
Gypsum	r164,164	110,841	155,892
Salt, all types	289,849	e300,000	241,000
Stone, sand and gravel thousand tons	r20,520	36,016	42,233
Sulfur, byproduct of petroleum and natural gas	82,000	90,000	95,000
MINERAL FUELS AND RELATED MATERIALS			
Carbon black[e]	r48,132	r52,251	77,960
Coal, bituminous	60,127	86,600	113,700
Gas, natural:			
Gross million cubic feet	r1,342,234	1,311,404	1,324,718
Marketable do	450,295	479,818	523,644
Natural gas liquids:			
Condensate thousand 42-gallon barrels	1,434	1,422	874
Natural gasoline do	7,328	7,271	7,158
Liquefied petroleum gas do	18,901	20,524	20,593
Total do	27,663	29,217	28,625
Petroleum:			
Crude do	856,364	839,740	816,820
Refinery products:			
Gasoline:			
Aviation do	242	672	710
Motor do	39,858	43,344	47,260
Naphtha do	19,044	22,781	20,141
Jet fuel do	8,251	9,113	10,706
Kerosine do	2,966	5,288	6,560
Distillate fuel oil do	49,938	45,278	50,054
Residual fuel oil do	178,302	216,028	200,645
Lubricants do	3,532	2,464	2,389
Other:			
Liquefied petroleum gas do	2,553	2,643	3,204
Asphalt and bitumen do	3,442	3,734	4,285
Refinery gas[3]	5,283	6,807	6,766
Unspecified do	3,634	2,734	3,028
Total do	317,045	360,886	355,748

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, lime is also produced, but available information is inadequate to make reliable estimates of output levels.

[2]Includes N content of mixed fertilizers for which gross weight figure is reported.

[3]Liquid equivalent.

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TRADE

In 1977, Venezuela dropped from fifth to seventh place in world export of crude oil and refined products. It was the second consecutive year that Venezuela failed to rank as the largest supplier of U.S. petroleum imports, again surpassed by Saudi Arabia and Nigeria. This was a consequence of the rapid increase in U.S. crude oil imports and the overall decline in total Venezuelan crude oil exports. Direct petroleum-related exports to the United States averaged 707,000 barrels per day in 1977, a slight increase over 1976 exports. Refined products accounted for 58% of these U.S. imports. Almost one-third of Venezuelan petroleum exports, primarily crude oil, were shipped to Caribbean refineries; about half of this was reexported to the United States in the form of refined products. Thus, through direct and indirect importation, the United States accounted for about one-half of total Venezuelan petroleum exports. Through the marketing authority that PDVSA granted to Corp. Venezolana del Petróleo S.A. (CVP), Lagoven S.A., and Maraven S.A., Venezuela directly sold over 500,000 barrels of petroleum per day to some 50 nontraditional customers, an amount equal to about 25% of total petroleum exports. The remaining 75% was handled through marketing agreements with former concessionaires.

Venezuelan exports of petroleum and petroleum products, by principal area of destination, during 1975-77 are shown in the following tabulation, in thousand 42-gallon barrels:[2]

Destination	1975	1976	1977
Western Hemisphere:			
Canada	98,798	102,779	90,600
Curaçao and Aruba	176,762	196,104	158,821
Puerto Rico	44,648	46,018	47,392
United States	250,260	252,488	257,981
Other	102,937	94,547	101,871
Total	673,405	691,936	656,665
Eastern Hemisphere:			
Europe:			
European Communities (EC)	66,855	63,946	38,482
Spain	6,909	7,256	7,755
Other	9,331	13,266	9,412
Total Europe	83,095	84,468	55,649
Asia and Far East	2,196	2,394	3,072
Africa	2,393	629	1,421
Other	--	644	--
Total	87,684	88,135	60,142
Undifferentiated	355	194	40
Grand total	761,444	780,265	716,847

Source: Ministry of Energy and Mines. Memoria y Cuenta Año 1975, 1976, 1977 (Caracas). March 1978.

Rising prices somewhat compensated for the steady decline in iron ore exports, which dropped to 11.9 million tons in 1977. Although this represented a 26% decrease from 1976 exports, the $242.5 million realized represented only a 6% decline from the value of 1976 iron ore export sales. The United States remained the principal market, accounting for 54% of 1977 iron ore exports, down 3% from that of 1976.

Table 2.—Venezuela: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal including alloys:			
Scrap	1,528		
Unwrought	10,410	11,296	Colombia 5,149; Peru 3,509; Argentina 1,119.
Semimanufactures	171	4,590	Colombia 2,346; Brazil 1,500; Peru 615.
Copper metal, semimanufactures	19	23	Colombia 18; Puerto Rico 3.

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Table 2.—Venezuela: Exports and reexports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Iron and steel:			
Ore and concentrate thousand tons	19,850	16,140	United States 9,200; Italy 1,888.
Metal:			
Pig iron, ferroalloys, similar materials	(1)	77	All to Dominican Republic.
Steel, primary forms	(1)	21	Mainly to Trinidad and Tobago.
Semimanufactures	1,649	20,373	Singapore 6,546; Nigeria 4,100; Hong Kong 3,153; Spain 2,480; Algeria 2,410.
Nickel metal including alloys, all forms	23	55	Mainly to United States.
Platinum-group metals and silver, waste and sweepings troy ounces	r4,565	5,465	All to United States.
Zinc metal including alloys, all forms	r298	236	United States 125; Brazil 89.
Other:			
Ash and residue containing nonferrous metals, n.e.s	(1)	3	All to Netherlands.
Oxides, hydroxides, peroxides of metals, n.e.s	r137,871	196,019	United States 62,896; Denmark 89,535; Brazil 39,389; Italy 19,853.
Metals including alloys, all forms, n.e.s	1	1	All to Netherlands.
NONMETALS			
Abrasives, natural:			
Pumice, emery, natural corundum, etc	3	1	All to Netherlands Antilles.
Grinding and polishing wheels and stones, n.e.s kilograms	r4,639	28,207	Mainly to Trinidad and Tobago.
Asbestos	(1)	--	
Cement, hydraulic	35,759	92	All to Netherlands Antilles.
Clays and clay products (including all refractory brick):			
Crude clays, unspecified	(1)	10	All to Colombia.
Products:			
Refractory	1,548	1,382	Argentina 972; Ecuador 319.
Nonrefractory	598	404	Puerto Rico 261; Netherlands Antilles 140.
Diamond, gem thousand carats	1,240	765	Netherlands 430; United States 245.
Fertilizer materials:			
Crude	3	5	All to Netherlands Antilles.
Manufactured	6,838	46,694	Brazil 26,747; Colombia 11,939; Peru 6,000.
Gypsum and plasters	16,960	17,800	Trinidad and Tobago 14,400; Surinam 3,400.
Lime	66	14	Brazil 7; Netherlands Antilles 7.
Precious and semiprecious stones, except diamond value, thousands	r$69	--	
Salt	975	(1)	All to Netherlands Antilles.
Sodium and potassium compounds, n.e.s	2,068	--	
Stone, sand and gravel:			
Dimension stone	1,962	1,465	Netherlands Antilles 570; St. Lucia 498.
Crushed and broken stone for cement and lime manufacture	114	351	All to Netherlands Antilles.
Quartz and quartzite	85	60	All to Poland.
Sand	2,995	481	Mainly to Trinidad and Tobago.
Sulfur:			
Elemental	7,419	18,931	Mainly to Colombia.
Sulfuric acid	13,859	15,976	Netherlands 5,989.
Other: Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	1,277	2,880	Mainly to Netherlands Antilles.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	20,493	75,061	Argentina 50,779; Brazil 18,813.
Hydrogen, helium, rare gases	6	19	Colombia 16; Netherlands Antilles 3.
Natural gas liquids:			
Natural gasoline thousand 42-gallon barrels	3,894	3,505	United States 2,378; Netherlands 652.
Liquefied petroleum gas do	10,907	12,019	United States 6,781; Argentina 1,630.
Petroleum:			
Crude and partly refined do	541,310	502,065	Netherlands Antilles 171,696; United States 130,035; Canada 84,238.
Refinery products:			
Gasoline and naphtha do	15,739	19,136	United States 12,944.
Jet fuel do	3,136	3,360	United Kingdom 1,046; Peru 1,009; United States 544; Netherlands 336.
Kerosine do	--	106	All to Honduras.
Distillate fuel oil do	25,109	20,941	Sweden 3,397; United Kingdom 1,836.
Residual fuel oil do	166,001	221,827	United States 159,503; Netherlands Antilles 22,597.
Lubricants do	2,208	1,366	Brazil 403; Sweden 331; France 217.
Asphalt do	529	81	Dominican Republic 42; Guatemala 15; Bahamas 9; Bermuda 9.
Other do	3,002	2,505	Argentina 957; West Germany 920.
Total do	215,724	269,322	

rRevised.
(1)Less than 1/2 unit.

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Table 3.—Venezuela: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite and concentrate	3,545	10,006	Mainly from Guyana.
Oxide and hydroxide	62,390	328,787	Jamaica 96,574; Guyana 66,345; Surinam 61,700; United States 59,295; Virgin Islands 34,271.
Metal including alloys:			
Unwrought	109	2,186	Mainly from Japan.
Semimanufactures	8,564	8,991	United States 4,104; United Kingdom 1,512.
Antimony metal including alloys, all forms	r83	101	Italy 32; Japan 31; United States 27; Peru 10.
Arsenic trioxide, pentoxide, acids	36	31	Mexico 13; United States 11; West Germany 6.
Chromium:			
Chromite	5,000	12,500	Mainly from Philippines.
Oxide and hydroxide	131	135	United States 91; West Germany 14.
Copper:			
Ore and concentrate	5	1	Mainly from Spain and Brazil.
Copper sulfate	281	190	West Germany 38; Chile 35; France 30; Netherlands 20; Peru 20; U.S.S.R. 19.
Metal including alloys:			
Scrap	418	139	Puerto Rico 56; United States 52; Italy 31.
Unwrought	3,866	4,217	United States 2,597; Canada 654; West Germany 526.
Semimanufactures	12,898	18,430	Chile 6,393; United States 4,247; Canada 3,558; West Germany 1,839.
Gold metal, unworked or partly worked troy ounces	r13,696	29,417	United States 18,068; Peru 9,066.
Iron and steel:			
Ore and concentrate	58	267,266	Mainly from Peru.
Metal:			
Scrap	56,174	44,493	United States 32,844; Yugoslavia 9,950.
Pig iron, ferroalloys, similar materials	168,527	129,953	India 58,077; United States 18,174.
Steel, primary forms	549,843	615,696	Japan 260,754; Belgium-Luxembourg 89,390; Italy 86,952.
Semimanufactures:			
Bars, rods, angles, shapes, sections	198,275	352,719	Japan 187,102; West Germany 37,804.
Universals, plates, sheets	409,792	399,166	Japan 281,966.
Hoop and strip	5,418	5,994	Japan 2,157; United States 1,233; West Germany 873; United Kingdom 630.
Rails and accessories	8,910	18,228	United States 14,882.
Wire	5,038	5,195	Japan 1,139; Brazil 899; United States 820; Belgium-Luxembourg 813.
Tubes, pipes, fittings	172,146	66,848	West Germany 17,739; United States 13,568; Japan 12,222; Italy 10,584.
Castings and forgings, rough	7,827	3,287	United States 1,600; United Kingdom 691; Spain 352; Belgium-Luxembourg 348.
Total	807,406	851,437	
Lead:			
Oxides	1,085	2,444	Mexico 1,671; United States 422.
Metal including alloys, all forms	9,693	8,712	Puerto Rico 3,926; United States 2,362.
Magnesium metal including alloys, all forms	325	185	United States 163; Norway 19.
Manganese:			
Ore and concentrate	103	5	All from United States.
Oxide	1,152	1,645	Mexico 864; United States 569; Japan 187.
Mercury 76-pound flasks	456	479	United States 233; West Germany 209.
Molybdenum metal including alloys, all forms	8	8	Netherlands 1; United Kingdom 1; United States 1.
Nickel:			
Matte, speiss, similar materials	3	(1)	All from Italy.
Metal including alloys, all forms	r588	661	United States 314; Japan 85.
Platinum-group metals including alloys, all forms troy ounces	r25,817	143,681	Spain 59,800; Switzerland 55,942; United States 16,011.
Silver metal including alloys do.	437,314	709,340	United States 529,104; France 77,997.
Tin:			
Oxides	12	13	Mainly from United States.
Metal including alloys, all forms	r657	380	United States 194; Switzerland 88; Netherlands 58.
Titanium oxides	1,290	6,352	United States 4,936.
Tungsten metal including alloys, all forms	10	36	United States 32.
Uranium metal including alloys, all forms kilograms	7	--	

See footnotes at end of table.

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Table 3.—Venezuela: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Zinc:			
Oxides	883	300	West Germany 100; United States 82; Colombia 46; United Kingdom 42.
Metal including alloys:			
Scrap and blue powder	244	250	United States 177; West Germany 40; Belgium-Luxembourg 31.
Unwrought	9,798	13,864	Canada 4,669; Mexico 3,631; Belgium-Luxembourg 2,063.
Semimanufactures	377	1,076	Mexico 901; Japan 100.
Other:			
Ores and concentrates	417	575	United States 314; Australia 157.
Ash and residue containing nonferrous metals	2	1	Mainly from Spain.
Oxides, hydroxides, peroxides of metals, n.e.s.	375	1,020	United States 832.
Metals including alloys, all forms	r330	164	United States 125.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc.	140	160	United States 55; Italy 45; West Germany 41.
Grinding and polishing wheels and stones	86	113	United States 39; Italy 26; West Germany 22.
Asbestos	15,548	17,624	Canada 14,564.
Barite	29,923	41,729	United Kingdom 17,887; Peru 11,197; Ireland 6,402; United States 6,043.
Boron materials:			
Crude natural borates	439	92	United States 66; Netherlands 25.
Oxide and acid	702	242	United States 207; West Germany 32.
Salts	r1,269	1,224	Mainly from United States.
Cement	29,337	592,384	Spain 233,534; Mexico 162,403; France 84,813.
Chalk	518	468	France 418.
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite	7,419	19,233	Mainly from United States.
Kaolin	16,542	24,530	United States 21,616; United Kingdom 2,708.
Other	3,756	4,692	Mainly from United States.
Products:			
Refractory (including nonclay brick)	7,666	19,697	United States 17,735.
Nonrefractory	16,377	52,959	Italy 29,092; Colombia 16,948.
Cryolite and chiolite	11	23	West Germany 18; Denmark 5.
Diamond:			
Gem, not set or strung, thousand carats	770	150	Mainly from Netherlands.
Industrial, do.	485	2,140	Belgium-Luxembourg 1,100; United States 975.
Diatomite and other infusorial earth	3,978	4,193	United States 2,655; Mexico 1,426.
Feldspar, leucite, nepheline, nepheline syenite	r201	696	United States 413; Finland 80.
Fertilizer materials:			
Crude	4	1	Mainly from United States and France.
Manufactured:			
Nitrogenous	250,966	217,446	Belgium-Luxembourg 88,664.
Phosphatic	4,587	--	
Potassic	22,859	8,816	Mainly from Austria.
Other	71	6	Mainly from West Germany.
Ammonia	r20	22	West Germany 15; United Kingdom 3; United States 2.
Fluorspar	390	5,429	Mexico 2,818; United States 2,501.
Graphite, natural	279	405	United States 287; Spain 92.
Gypsum and plasters	589	569	West Germany 240; United States 140; United Kingdom 112.
Iodine	7	12	United States 5; West Germany 2; United Kingdom 2; Japan 1; Netherlands 1.
Lime	60	127	All from United States.
Magnesite	8,691	377	Czechoslovakia 308.
Mica:			
Crude, including splittings and waste	412	282	Mainly from United States.
Worked, including agglomerated splittings	7	7	United States 5; Italy 1; Japan 1.
Pigments, mineral:			
Natural, crude	56	15	United Kingdom 10; United States 3.
Iron oxides, processed	1,228	1,273	Spain 399; Netherlands 310; West Germany 266.
Precious and semiprecious stones, except diamond, natural and synthetic, kilograms	2,919	7,192	Chile 3,928; Brazil 942; Mexico 771.
Pyrite	37	81	All from United States.
Salt	78	24	United States 21; West Germany 3.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	65,884	53,680	United States 35,676; Panama 12,077.
Caustic potash and sodic and potassic peroxides	457	69	United States 34; West Germany 22; France 10.
Soda ash	27,654	69,974	Mainly from United States.
Stone, sand and gravel:			
Dimension stone, crude and worked	7,890	6,195	Italy 4,404.
Gravel and crushed stone	255	93	France 70; West Germany 13; Norway 10.
Dolomite, chiefly refractory grade	33,696	16,013	Mainly from United States.
Quartz	133	95	Sweden 62; United States 28.
Sand	252	209	Mainly from United States.

See footnotes at end of table.

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Table 3.—Venezuela: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Sulfur:			
Elemental:			
Other than colloidal	44	117	West Germany 76; United States 37.
Collodial	r25	77	Belgium-Luxembourg 61; United States 11.
Sulfur dioxide	r122	102	Mainly from United States.
Sulfuric acid	r53	126	West Germany 36; Sweden 32; United States 29; United Kingdom 14.
Talc and steatite	6,492	8,227	United States 6,229.
Other:			
Crude:			
Vermiculite	438	507	Mainly from Africa.
Mineral substances, n.e.s	r21	31	All from France.
Slag, dross, and similar waste, not metal bearing	3	4,610	Mainly from West Germany.
Oxides and hydroxides of magnesium, strontium, barium	13,241	22,253	Japan 18,208; United States 3,732.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	671	3,558	Colombia 2,271; United States 1,109.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	451	469	All from United States.
Carbon black and gas carbon	576	791	United States 369; Japan 135; West Germany 115; Colombia 90; Canada 79.
Coal, all grades, including briquets	7,407	13,564	Mainly from United States.
Coke and semicoke of coal and lignite	288,008	184,578	Poland 69,879; Japan 55,024; Colombia 26,244; United States 20,460.
Hydrogen, helium, rare gases	42	8	Mainly from United States.
Peat, including briquets and litter	24	38	West Germany 20; Finland 11; Netherlands 7.
Petroleum:			
Crude and partly refined ---42-gallon barrels	308	4,188	Mainly from Sweden.
Refinery products:			
Gasoline ---do---	603	134	United States 88; United Kingdom 20; West Germany 13.
Kerosine and jet fuel ---do---	r2,032	3,024	United States 2,143; Netherlands 847.
Distillate fuel oil ---do---	1	1	All from United States.
Residual fuel oil ---do---	(1)	(1)	All from El Salvador.
Liquefied petroleum gas ---do---	124	40	Mainly from United States.
Lubricants ---do---	r152,620	108,159	United States 63,762; Curaçao 26,337; Netherlands 15,420.
Other:			
Mineral jelly and wax ---do---	33,051	32,250	United States 17,826; West Germany 7,710.
Nonlubricating oils, n.e.s ---do---	2	6	United States 4; West Germany 1.
Pitch and pitch coke ---do---	r125,352	62,885	United States 55,138; Colombia 7,605.
Petroleum coke ---do---	110,761	103,736	Mainly from United States.
Bitumen and other residues ---do---	1,693	1,607	Japan 1,408.
Bituminous mixtures, n.e.s ---do---	r970	415	Mainly from United States.
Total ---do---	427,209	312,257	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	10,220	17,296	Mainly from United States.

rRevised.
1Less than 1/2 unit.

COMMODITY REVIEW

METALS

Aluminum.—Aluminio del Caroní S.A. (ALCASA) remained Venezuela's sole producer of aluminum during 1977. ALCASA's total output of about 43,400 tons represented a 6.7% decline from that of 1976, at least partially caused by the effects of a protracted strike. Toward yearend, ALCASA completed its latest expansion program, which brought total plant capacity to 124,000 tons of aluminum per year.

At Ciudad Guayana, construction schedules were maintained on Venezuela's second aluminum smelter, projected to come onstream during the first half of 1978. The new smelter company, Indústria Venezolana de Aluminio, C.A. (VENALUM), is a joint venture between the Government and a Japanese consortium. Corp. Venezolana de Guayana (CVG) has an 80% interest in the new company, with the remainder divided between six Japanese companies: Showa Denko K.K. (7%), Kobe Steel, Ltd. (4%), Sumitomo Light Metal Industries, Ltd. (4%), Mitsubishi Metal Corp. (2%), Mitsubishi Chemical Industries Ltd. (2%), and Marubeni Trading Co. (1%). The new plant

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will have four potlines of 180 cells each. Each line will have an annual capacity of 70,000 tons. The lines will come onstream at 6-month intervals until total plant capacity of 280,000 tons is reached in 1980. The output will include ingots, billets, and rolling ingots. The Japanese partners received priority rights to purchase 160,000 tons of aluminum annually, with the remaining 120,000 tons of plant output destined for Venezuelan or foreign markets. Some of the uncommitted 120,000 tons of plant output will probably go to Andean Pact countries; some may go to ALCASA; and eventually, about 50,000 tons will be purchased by Suramericana de Aleaciones Laminadas C.A. (SURAL), a joint venture between the U.S. firm Southwire Co. and private Venezuelan interests. SURAL is engaged in production of aluminum alloy rods for export to the United States, Puerto Rico, and Europe.

Venezuela has imported alumina from the United States, Guyana, Surinam, and Jamaica, but eventually both ALCASA and VENALUM will obtain alumina from a new bauxite reduction plant at Ciudad Guayana. The new facility, Interamericana de Alúmina C.A. (INTERALUMINA), is a joint venture between CVG and the Swiss firm Alusuisse. CVG controls 85% of the corporation, and Alusuisse and Billiton International Metals B.V. each own 7.5%. Plant construction is scheduled to begin in early 1978, with the first of two 500,000-ton-per-year alumina production lines expected to become operational in mid-1981. The second line is expected to come onstream in 1982, bringing plant capacity to an impressive 1 million tons of alumina per year. The plant will use gas from the Guayana region. It was originally planned to use imported bauxite, since Venezuela had no proven reserves of this ore when the project was conceived.

Shortly after finalizing the INTERALUMINA project agreement, it was announced that a major high-quality bauxite deposit had been discovered on a 700-meter-high plateau in south-central Venezuela in the Los Pijiguaos hills of Bolívar State. Located about midway between the towns of Caicara and Puerto Ayacucho, this discovery culminated an intensive search begun by CVG in 1974. The bauxite deposit has an average thickness of 11 meters, with very little overburden reported. Prospecting by drilling and gridding techniques over a 30-square-kilometer area confirmed a reserve estimate of 500 million tons of bauxite ore, with adjacent areas containing an additional reserve potential. Preliminary analyses indicated that the ore contains 50% to 52% aluminum oxide, primarily in the trihydrate form, with no more than than 1.5% monohydrate. Silica, chiefly in the form of fine-grained quartz, composes 6% to 10% of the ore, and iron oxide composes 8% to 12%. Very small quantities of titanium dioxide are also present, but virtually no clay is found except in the form of reactive silica. CVG expressed confidence that mine production and ore deliveries to INTERALUMINA would commence by 1982. CVG began construction on 35 kilometers of access road; however, transportation of the projected 2 million tons of ore per year to the bottom of the steep plateau and thence to Ciudad Guayana is expected to present the major problem to mining development.

Iron Ore.—The world steel recession continued to adversely affect the production and export of iron ore by Ferrominera Orinoco C.A., a wholly owned subsidiary of CVG. In 1977, total ore production amounted to only 14.4 million tons, compared with 26.4 million tons in 1974 and 18.7 million tons in 1976. This represents a decline of 23% from 1976 production and more than 45% from 1974 production. Exports also decreased 26% from the 1976 level of 16.1 million tons to 11.9 million tons in 1977. Gradual price increases have compensated for the reduced exports, and gross iron ore income has remained relatively stable for the last 4 years. Although iron ore accounted for only 2% of total Venezuelan exports, it remained second only to oil in importance. Ferrominera's iron ore shipments in 1977, by destination, are given in the following tabulation, in thousand tons:

Destination	Shipments
United States	6,394
Italy	1,805
Germany, Federal Republic of	975
Spain	631
Belgium-Luxembourg	509
Netherlands	307
Czechoslovakia	295
United Kingdom	284
Poland	141
Argentina	106
Portugal	96
Austria	20
Other	373
Domestic	170
Total	12,106

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Iron and Steel.—Technical and labor difficulties at the CVG Siderúrgica del Orinoco C.A. (SIDOR) steel facility in Ciudad Guayana caused its output to drop to slightly more than 50% of capacity. SIDOR's plant expansion, begun 3 years ago, was reported to be about 30% complete. This ambitious project, scheduled for 1980 completion, will raise SIDOR's annual capacity from 1.25 million tons to 4.8 million tons. The successful conclusion of this expansion scheme will establish Venezuela as the only country in the world to have 4 million tons per year of integrated capacity on line in a single project.

Expansion and new projects in the steel and aluminum industries and their supporting infrastructures have made apparent the importance of increasing electrical generating capacity for the successful development of the Guayana region. A contract was awarded to a Brazilian-Venezuelan consortium for construction of the final stage of the Guri hydroelectric complex on the Caroní River, targeted for completion in 1983, with full capacity of 9,000 megawatts to be reached in 1988.

Late in 1977, Corp. de Desarrollo de la Región Zuliana (CORPOZULIA) awarded a management contract to British Steel Corp. for a new steel complex to be built near Maracaibo in the State of Zulia. The projected output of this new complex is 1.25 million tons by 1990. The year ended with financial arrangements for the steel project still uncertain, but in December, bids were invited for a 49% foreign equity participation. Several international groups were reported to have expressed interest, and a selection is anticipated in 1978.

Other.—The Government received participation offers from several international companies for development of the zinc-copper-lead-silver reserves at Bailadores in the State of Mérida. A final partnership selection was not completed by yearend.

MINERAL FUELS

Coal.—Coal production during 1977 totaled 113,700 tons, a 31% increase over that of 1976. The Naricual mines located about 25 kilometers south of Puerto La Cruz, under development by C.A. Minas de Naricual (CAMINA), contributed 46% of total production, and the Lobatera mines in the State of Táchira produced 51%.

The proximity of the Naricual mines to SIDOR's steelmaking facility in Ciudad Guayana was the major factor for the Government's 1974 decision to rehabilitate them. Labor, financial, and operational difficulties prevented CAMINA from meeting its 1977 production goal. SIDOR reportedly expressed some doubts as to the acceptability of the quality of CAMINA's test coking samples to meet its needs.

The Lobatera mines are under development by C.A. Minas de Carbón de Lobatera, with financial and administrative assistance provided by Corp. de Los Andes (CORPOANDES), Corp. Venezolana de Fomento (CVF), the Ministry of Energy and Mines, and a Polish consulting firm. Lobatera's reserves were estimated to be at least 60 million tons, with additional deposits in neighboring areas. The Government visualized the establishment of coke and cement plants to create increased demand for Lobatera coal, which it considers to be Venezuela's highest quality industrial coal. The relative inaccessibility of the region remained a major obstacle to rapid development.

CORPOZULIA, the regional development authority for Zulia State, planned to have its first open pit coal mine in the Guasare fields operational in 1978. The infrastructure network necessary to advance this uninhabited and remote area to its potential will require a massive effort. The coking quality of the coal also remained a major consideration. Preliminary analyses indicated that the coal contains a low percentage of ash but high amounts of volatile matter. Tests indicated that coal from lower seams, not scheduled for immediate development, may require less mixing with imported coal to produce the best metallurgical coke. Upper seams have been tested with fair results, using domestic-to-imported blends of 60:40 and 50:50. A 100-kilometer railroad is planned to connect the first Guasare coalfield mine at Paso el Diablo to the site of the future CORPOZULIA steel complex in Maracaibo. Initial production will be used for definitive analyses of the coking properties of the coal. In addition to providing coke for the new steel facility, CORPOZULIA believed it could provide 1 million tons of coal per year by 1984 to the thermal power station programed for the Maracaibo region.

Petroleum and Natural Gas.—PDVSA completed its second year controlling the nationalized petroleum industry. The 14 subsidiary companies originally established to operate under PDVSA's administration concentrated on expansion of development and exploration activities that had been neglected for some years prior to nationalization. In late 1977, Llanoven S.A., Palma-

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ven S.A., and Roqueven S.A. were merged into the larger CVP. Further integration of the remaining PDVSA subsidiaries is expected to take place in 1978. PDVSA and its subsidiaries are subject to the same degree of Government regulation and taxation as were the former private companies. They are also limited for production purposes to the concession areas originally assigned to their private predecessors, but they are permitted to participate in exploration work outside these prescribed concession areas.

Despite some successful exploration and enhanced recovery programs, Venezuela's 1977 crude oil reserves were estimated at 18 billion barrels, a slight decrease from estimated 1976 reserves. Exploration expenditures were over $100 million during 1977, and $200 million has been budgeted for 1978. Light- and medium-gravity oils found in the deep Cretaceous wells drilled in the El Oriente and Lake Maracaibo areas continued to receive priority attention. Some Cretaceous wells exceeded 10,000 feet in total depth, and tests scheduled for 1978 are expected to reach 18,000 to 22,000 feet.

Preparatory work continued for the three-phase offshore exploration program, with the first drilling expected in 1978. The first exploratory phase includes the La Vela Embayment, the Golfo Triste, and an area off the Orinoco River delta. Phase 2 will include the area around Margarita Island and the northern part of the Gulf of Paria; final areas for phase 3 have not been selected. PDVSA hopes to expand reserves by at least 10 billion barrels of recoverable, light- to medium-gravity oil offshore, with perhaps an additional 26 billion to 64 billion barrels of probable reserves.

Exploration and development drilling continued to suffer from a shortage of drilling rigs and crews, although the total number of drilling and workover rigs increased slightly in 1977 and additional new rigs are expected during 1978. A total of 47 exploratory wells were drilled in 1977; 28 of these were successful, including 22 in the Cretaceous zone of the Lake Maracaibo and El Oriente regions.

Development activities for the heavy, mineral-laden oils of the Orinoco basin were transferred from the Ministry of Energy and Mines to PDVSA. The Instituto Tecnológico Venezolana de Petróleo (INTEVEP) conducts and evaluates improved recovery and related research on these heavy oils under the direction of PDVSA. It has been estimated that the Orinoco basin contains at least 700 billion barrels of oil, and deep drilling has encouraged speculation that there may be as much as 3 trillion barrels of oil in place with a current recovery factor of 10%. The high cost of producing, demetalizing, and upgrading these oils has remained a deterrent to extensive development, but several schemes to upgrade the oil and enhance recovery to perhaps 14% to 20% were under active study. During 1977, the three fields in the Orinoco basin produced about 150,000 barrels of oil per day.

Although the number of producing wells throughout Venezuela during 1977 dropped to 10,202 and production fell to 2.2 million barrels per day, the overall performance improved. Thermal recovery projects, workovers, and development drilling increased the number of flowing wells by 100. The number of pumping wells decreased to 8,111 from 9,876 in 1976. The average production per well was 219.4 barrels per day during 1977, compared with 193.3 barrels per day in 1976. Over $600 million was projected for capital investment in production activities during 1978, compared with $322 million in 1977 and $196 million in 1976. Light- and medium-gravity crude oil production dropped 7%, accounting for 70% of total output as opposed to 73% in 1976, while heavy crude oil production increased 9% over that of 1976. This trend toward increased production of heavy-gravity crude influenced PDVSA's development and exploratory planning.

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A distribution of crude oil output in 1977 by gravity, region, and operating subsidiary of PDVSA, in thousand 42-gallon barrels, is shown in the following tabulation:

	Production	Percent of total
By gravity:		
Light (over 30° API)	291,226	36
Medium (22° to 30° API)	278,015	34
Heavy (below 22° API)	247,576	30
By region:		
Lake Maracaibo	635,159	78
El Oriente	168,254	20
Other	13,404	2
By operating subsidiary:		
Lagoven S.A	331,628	40
Maraven S.A	195,113	24
Meneven S.A	139,651	17
Palmaven S.A	38,438	5
CVP	28,783	3
Llanoven S.A	22,412	3
Deltaven S.A	21,163	3
Roqueven S.A	12,830	2
Amoven S.A	8,460	1
Bariven S.A	7,867	1
Boscaven S.A	7,720	1
Taloven S.A	1,184	(1)
Guariven S.A	881	(1)
Vistaven C.A	687	(1)

[1]Less than 1/2 unit.

Source: Ministry of Energy and Mines. Petróleo y Otros Datos Estadísticos, 1977 (Caracas). October 1978.

Gross natural gas production increased slightly to about 3.6 billion cubic feet per day, of which 54% was reinjected, 38% was sold for domestic purposes, and 8% was flared.

Domestic consumption of petroleum products accounted for 11.5% of total crude oil production, but because of low domestic prices, only about 4.5% of total revenue is accountable to internal sales. An average 6% annual increase in domestic consumption of petroleum products, particularly gasoline, and the increase in heavy crude oil production partially influenced PDVSA's $1.5 billion program to upgrade its major refineries over the next 5 years. During 1977, over 970,000 barrels per day was refined by the 12 refinery complexes operated by four PDVSA subsidiaries. Total refinery capacity in 1977 was about 1,445,000 barrels per day. Actual production resulted in a 67% refinery utilization factor.

Marketing or offtake agreements were signed with multinational companies at the time of nationalization, an action that assured Venezuela market continuity for a major portion of its petroleum exports and provided the former concessionaire companies with assured supplies. These agreements accounted for about 75% of petroleum export sales in 1977. Some of these agreements have expired, but the most important ones were renewed for an additional 2-year period. Market diversification, a recognized national goal, was partially realized when CVP, Lagoven, and Maraven were authorized to sell on the international market. Their share of sales amounted to 25% of total petroleum exports during 1977 and was expected to gradually increase in the future.

The United States remained the major purchaser of Venezuelan petroleum exports. Western Hemisphere markets received almost 92% (by volume) of these exports, as follows: The United States 36%, Caribbean countries 33%, Canada 13%, and Central and South American countries 10%. Two-thirds of the petroleum exports consisted of crude oil; the remainder were refinery products, mainly fuel oils.

PDVSA determines the price of crude oil in accordance with Government policy and at levels established by the Organization of Petroleum Exporting Countries (OPEC). Having the widest range of crude oil types of any OPEC member, Venezuela has a correspondingly wide range of export prices. Refinery product prices are not subject to OPEC price levels and are adjusted by PDVSA on a quarterly basis, with the exception of the fuel oil price, which is adjusted monthly.

[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Venezuelan bolivars (Bs) to U.S. dollars at the rate of Bs4.3 = US$1.00.

[3]Data may differ from that reported elsewhere in this chapter owing to a difference in source.

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The Mineral Industry of Yugoslavia

By Roman V. Sondermayer[1]

Yugoslavia maintained its position as one of the leading producers of nonferrous metals in Europe during 1977. The more prominent minerals, with production in 1977 expressed as a percentage of world output, were as follows: Magnesite and lead each 4%, antimony 3%, bauxite and zinc each 2%, and copper 1%. Production of other minerals was of only domestic significance. Lignite remained the principal fuel produced in the country. Imports of liquid fuels and high-rank coals were required to meet the growing energy demand. Economic difficulties in the country and abroad affected financial results of most mining and mineral-processing enterprises, and some of them faced serious problems in meeting their loan obligations.

The mineral industry, including processing and construction materials, contributed about 11% of the gross social product[2] and employed approximately 6% of the labor force, or 320,400 persons.

The general economic condition of the country was characterized by inflation (14%), unemployment (13%), and economic growth (7%). The mineral industry had financial problems, but expansion of processing facilities for some minerals (such as bauxite) and expansion of mining facilities for others (lead, zinc, and copper) continued.

In certain parts of the country, geological exploration was far behind contracts and plans. In Serbia, only about 48% of the exploration contracts to be completed in 1977 were actually completed.

The mineral industry had a mixed year, but there were a number of important events related to minerals. The socialized economy, with loans from the Government-owned banks, made continued investments possible in an unfavorable economic climate. The principal events included beginning of construction of an aluminum smelter near Mostar, Bosna i Hercegovina (or Bosnia and Hercegovina); continuation of construction of alumina plants near Zvornik, Bosnia and Hercegovina, and Obrovac, Hrvatska (or Croatia); a decision to develop the Veliki Krivelj copper deposit located in the general area of Bor, Srbija (or Serbia); closure of the mercury mine and smelter at Idria, Slovenija (or Slovenia); development of a nickel mine and construction of a ferronickel smelter near Kavadarci, Makedonija (or Macedonia); expansion of zinc electrolytic plants at Sabac and Kosovska Mitrovica, both in Serbia; beginning of development of a new lignite mine at Tamnava, Serbia; beginning of construction of a gas pipeline system through Slovenia; and completion of expansion of the petroleum refinery at Rijeka, Croatia.

PRODUCTION

The mineral industry was State owned; however, investment of foreign capital in Yugoslavia's mineral industry was allowed, providing that Yugoslavia retained ownership of the deposit and controlling interest in the venture. Nevertheless, except for one recent investment in the petrochemical field, no foreign investments have as yet been made in the mineral industry. The size of enterprises ranges from large integrated operations, mostly in production of metals, to small mines, mostly in production of

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nonmetals. The following tabulation lists the major enterprises and their principal facilities operating in Yugoslavia during 1977, with their share of national totals.

Commodity	Major companies[1]	Principal facilities	Percent of domestic output
Aluminum	Tvornica Lakih Metala Boris Kidric	Smelter at Sibenik (Croatia)	55
Antimony	Rudarsko Topionicarski Basen Zajaca	Smelter at Zajaca; mine at Kopaonik Mountain (Serbia).	100
Bauxite	Energoinvest	Mines at Vlasenica (Bosnia and Hercegovina).	55
Coal, brown	Titovi Rudnici Kreka-Banovici	Mines at Kreka, Banovici, Breza, Kakanj (Bosnia and Hercegovina).	35
Copper metal	Rudarsko Topionicarski Basen Bor	Mines at Bor and Majdanpek; smelter at Bor (Serbia).	100
Lead, smelter	Rudarsko-Metalurski Kombinat Trepca.	Mine at Stari Trg; smelter at Zvecan (Serbia).	75
Lignite	Rudarsko Energetsko Industrijski Kombinat Kolubara.	Mines at Kolubara and Tamnava (Serbia)	30
Petroleum	Industrija Nafte	Oilfields at Benicanci and Struzec; refineries at Rijeka and Sisak.	72
Steel, crude	Rudarsko-Metalurski Kombinat Zenica	Integrated iron and steel works at Zenica (Bosnia and Hercegovina).	37
Zinc, smelter	Zletovo, Topilnica za Cink i Olovo	Imperial smelter at Titov Veles (Macedonia).	36

[1]All State-owned.

Table 1.—Yugoslavia: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1975	1976	1977[p]
METALS			
Aluminum:			
Bauxite thousand tons	2,306	2,033	2,044
Alumina	283,090	455,276	e480,000
Metal, ingot, including secondary	166,270	197,679	197,451
Antimony:			
Mine output, metal content	2,183	2,021	e2,100
Metal (regulus)	2,159	2,332	1,024
Bismuth, smelter	55	78	74
Cadmium, smelter[e]	270	290	300
Chromium:			
Ore (domestic production)	1,694	2,022	e2,000
Concentrate (produced largely from imported ore)	38,482	34,911	e35,000
Copper:			
Mine output, metal content	114,894	120,130	e121,000
Blister, including secondary	162,012	164,139	e165,000
Refined (electrolytic):			
Primary	123,887	121,587	92,977
Secondary	14,015	14,883	28,173
Gold troy ounces	177,922	157,088	e160,000
Iron and steel:			
Iron ore, gross weight thousand tons	5,239	4,260	4,451
Pig iron do	2,000	1,918	1,938
Ferroalloys:			
Ferromanganese	30,674	22,211	192,000
Ferrochrome	53,902	42,770	
Ferrosilicon	83,168	98,668	
Ferrosilicomanganese	14,409	25,848	
Ferrosilicochrome	10,050	7,123	
Other	2,529	3,716	
Crude steel thousand tons	2,917	2,751	3,814
Semimanufactures do	2,359	2,440	3,329
Lead:			
Mine output, metal content	126,896	122,466	e125,000
Metal:			
Smelter, crude, including secondary	140,018	140,383	e150,000
Refined, including secondary	126,099	111,220	129,890
Manganese ore and concentrate, gross weight	16,925	19,000	e19,000
Mercury 76-pound flasks	16,941	12,503	NA
Selenium, elemental kilograms	43,320	45,080	50,360
Silver, refined, including secondary thousand troy ounces	5,412	4,631	4,694
Zinc:			
Mine output, metal content	103,440	106,641	e110,000
Smelter, including secondary	97,605	105,495	98,842

See footnotes at end of table.

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Table 1.—Yugoslavia: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]		1975	1976	1977[p]
NONMETALS				
Asbestos		12,203	12,830	9,066
Barite		60,645	56,122	e60,000
Cement, hydraulic	thousand tons	7,065	7,621	8,007
Clays: Fire clay:				
Crude		349,747	315,000	e320,000
Calcined		99,198	78,532	e90,000
Feldspar, crude		54,548	25,386	e30,000
Fertilizer materials, manufactured:				
Gross weight:[2]				
Nitrogenous	thousand tons	865	920	e930
Phosphatic	do.	764	516	e520
Mixed	do.	184	128	e140
Nutrient content:				
Nitrogen in nitrogenous and mixed	do.	264	277	280
Phosphorus pentoxide in phosphatic and mixed	do.	162	96	96
Potassium oxide equivalent in mixed		19	NA	NA
Gypsum:				
Crude		449,568	422,260	e450,000
Calcined		96,159	82,470	e90,000
Lime:				
Quicklime	thousand tons	1,335	1,167	1,338
Hydrated	do.	748	760	e780
Magnesite:				
Crude		485,301	391,000	345,000
Sintered		256,588	189,884	e170,000
Caustic calcined		5,128	4,844	e5,000
Mica, all grades		86	68	e70
Quartz, quartzite, glass sand	thousand tons	1,605	1,607	e1,600
Salt:				
Marine		37,444	12,881	e14,000
From brines		179,530	186,000	e190,000
Rock		78,466	91,230	e90,000
Total		295,440	290,111	e294,000
Sand and gravel (except glass sand)	thousand cubic meters	14,122	14,505	NA
Stone (except quartz and quartzite):				
Dimension:				
Crude:				
Ornamental	do.	46	50	NA
Other	do.	1	1	NA
Partly worked facing	thousand square meters	749	779	NA
Cobblestones, curbstones, etc	thousand cubic meters	35	21	NA
Crushed and broken stone, n.e.s	do.	8,277	7,826	NA
Milled marble and other	do.	3,990	4,364	NA
Sulfur and pyrite:				
Pyrite:				
Gross weight	thousand tons	399	440	e460
Sulfur content	do.	168	185	NA
Elemental sulfur, byproduct:[e]				
Of metallurgy	do.	180	190	200
Of petroleum	do.	5	5	5
MINERAL FUELS AND RELATED MATERIALS				
Carbon black		19,240	21,795	e20,000
Coal:				
Bituminous	thousand tons	598	586	511
Brown	do.	9,429	9,110	8,960
Lignite	do.	25,509	27,149	29,611
Total	do.	35,536	36,845	39,082
Coke:				
Metallurgical	do.	1,263	1,686	NA
Breeze	do.	80	100	NA
Total	do.	1,343	1,786	1,765
Gas:				
Manufactured (city gas only)	million cubic feet	8,237	5,506	NA
Natural, gross production	do.	54,843	61,094	66,992
Natural gas plant liquids:				
Natural gasoline and pentane	thousand 42-gallon barrels	134	120	e130
Propane and butane	do.	622	445	e470
Total	do.	756	565	e600

See footnotes at end of table.

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Table 1.—Yugoslavia: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity[1]		1975	1976	1977[p]
MINERAL FUELS AND RELATED MATERIALS —Continued				
Petroleum:				
Crude oil:				
As reported	thousand tons	3,692	3,880	3,951
Converted	thousand 42-gallon barrels	27,347	28,739	29,266
Condensate:				
As reported	thousand tons	538	645	NA
Converted	thousand 42-gallon barrels	5,111	5,483	NA
Refinery products:				
Gasoline	do	14,833	16,346	18,964
Jet fuel	do	2,558	2,439	NA
Kerosine	do	84	78	---
Distillate fuel oil	do	22,696	23,409	25,737
Residual fuel oil	do	28,478	31,968	38,748
Lubricants	do	1,184	1,309	1,585
Other:				
Liquefied petroleum gas	do	2,442	2,660	e2,700
White spirits	do	217	248	NA
Paraffin	do	61	75	e80
Asphalt and bitumen	do	2,339	2,368	NA
Petroleum coke	do	282	306	e300
Total[3]	do	75,174	81,206	4e102,000

eEstimate. pPreliminary. rRevised. NA Not available.

[1]In addition to the commodities listed, germanium, platinum, palladium, bentonite, kaolin, common clay, and diatomite are also produced, and tellurium may be recovered as a copper-refining byproduct, but available information is inadequate to make reliable estimates of output levels.

[2]As reported in official Yugoslav production statistics; sum of actual reported gross weight for each class of fertilizer.

[3]Excludes refinery gas (11.6 billion cubic feet in 1975, 12.6 billion cubic feet in 1976, and an unreported quantity in 1977) as well as other materials produced by and used in the refineries as fuel.

[4]Includes a combined estimate of 13,886,000 barrels for entries given as NA.

TRADE

During 1977, Yugoslavia remained a net importer of minerals. Imports of minerals, valued at about $2.3 billion,[3] accounted for 30% of total imports. Fuels, mostly crude oil and bituminous coal, made up 48% of the country's mineral imports. Exports of minerals, valued at $800 million, made up about 17% of total exports.

Yugoslavia had a mineral trade surplus of about $122.5 million with the United States in 1976. Approximately 19% of total Yugoslav exports of minerals went to the United States, making up about 0.12% of total imports of the United States. Approximately 1% of total Yugoslav imports of minerals originated in the United States; this was about 0.2% of total exports of the United States.

Table 4 shows details of mineral trade between the United States and Yugoslavia in 1976.

Table 2.—Yugoslavia: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Bauxite and concentrate thousand tons	1,283	1,024	U.S.S.R. 660; Czechoslovakia 149; Romania 139.
Alumina	73,845	91,664	U.S.S.R. 61,382; Czechoslovakia 19,917.
Metal including alloys:			
Scrap	6,741	7,132	Italy 4,962; West Germany 1,957.
Unwrought	71,964	82,775	East Germany 44,213; United States 14,649.
Semimanufactures	51,695	61,578	Czechoslovakia 21,468; United States 10,115.
Antimony, regulus	1,306	775	Bulgaria 450; U.S.S.R. 325.
Bismuth metal including alloys, all forms	33	19	United States 18.
Cadmium metal including alloys, all forms	65	153	United States 133.
Chromium:			
Chromite	3,280	303	All to Czechoslovakia.
Oxide and hydroxide	193	184	West Germany 170.

See footnotes at end of table.

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Table 2.—Yugoslavia: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Copper:			
Copper sulfate	5,790	8,200	People's Republic of China 2,520; Bulgaria 2,100; Greece 2,010; Italy 1,500.
Metal including alloys:			
Scrap	154	221	All to Italy.
Unwrought	47,189	60,639	United States 42,780; Italy 9,450.
Semimanufactures	33,856	38,227	U.S.S.R. 12,328; United States 7,607; Czechoslovakia 4,212.
Iron and steel:			
Ore and concentrate	30,000	--	
Roasted pyrite	5,998	25,423	Hungary 19,427; Austria 5,996.
Metal:			
Scrap	21,637	19,642	Italy 12,641; West Germany 4,557.
Pig iron, ferroalloys, similar materials	171,613	129,233	United States 30,793; Italy 29,875; Romania 26,574; Poland 16,778.
Steel, primary forms	8,881	40,674	Romania 26,433; Italy 5,499; Bulgaria 5,112.
Semimanufactures:			
Bars, rods, angles, shapes, sections	66,489	125,538	U.S.S.R. 37,528; Czechoslovakia 30,529; Romania 14,996; Poland 13,606; West Germany 13,331.
Universals, plates, sheets	51,299	49,295	U.S.S.R. 26,778; West Germany 6,876.
Hoop and strip	1,649	10,234	Italy 6,898; Poland 3,173.
Rails and accessories	45,395	28,227	Romania 24,666.
Wire	738	1,500	East Germany 891; Italy 295.
Tubes, pipes, fittings	170,328	245,782	U.S.S.R. 74,553; East Germany 25,134.
Castings and forgings, rough	14,059	9,840	Poland 3,477; Czechoslovakia 2,102; East Germany 1,758.
Lead:			
Ore and concentrate	368	11,288	Bulgaria 5,917; U.S.S.R. 5,371.
Oxides	7	3	East Germany 2; U.S.S.R. 1.
Metal including alloys:			
Unwrought	66,253	47,153	United States 17,951; Austria 8,051; Czechoslovakia 5,405.
Semimanufactures	455	1,369	Italy 500; France 392; Kuwait 181; Saudi Arabia 142.
Manganese ore and concentrate	5,415	1,611	All to Italy.
Mercury 76-pound flasks	8,412	8,383	All to United States.
Nickel metal including alloys, all forms	207	447	West Germany 245; Italy 186.
Platinum-group metals including alloys, all forms: Palladium troy ounces	4,501	9,195	United States 4,823; West Germany 1,929; United Kingdom 1,318; Netherlands 965.
Selenium, elemental kilograms	NA	34	United States 31.
Silicon	16,507	20,132	U.S.S.R. 9,445; United States 2,158; Romania 2,056.
Silver metal including alloys, all forms thousand troy ounces	3,694	3,537	United States 2,540.
Tin metal including alloys, all forms	50	51	Austria 39; Italy 12.
Titanium oxide	13,547	14,219	East Germany 11,849.
Uranium ore and concentrate	2,015	--	
Zinc:			
Ore and concentrate	7,698	594	All to Italy.
Oxide	37	1,514	Romania 1,010.
Metal including alloys:			
Blue powder	3,233	4,359	Czechoslovakia 2,409; Poland 1,540.
Unwrought	51,208	47,963	Czechoslovakia 19,515; United States 17,194; Hungary 5,011.
Semimanufactures	7,351	7,480	West Germany 2,780; Czechoslovakia 2,435.
Other:			
Ash and residue of nonferrous metals	22,924	38,009	Bulgaria 32,139; Italy 4,525.
Oxides, hydroxides, peroxides of metals, n.e.s	47	70	Mainly to Sweden.
NONMETALS			
Abrasives, natural: Grinding and polishing wheels and stones	2,660	2,648	Poland 1,317; U.S.S.R. 362; Romania 300.
Asbestos	3,259	2,052	Albania 1,371; West Germany 511.
Barite and witherite	47,732	41,665	U.S.S.R. 24,197; Hungary 17,468.
Cement	431,205	460,652	Tunisia 197,610; Libya 84,998; United Arab Emirates 55,685.
Chalk	14	NA	
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite	848	303	Libya 202; Jordan 100.
Fire clay	5,212	3,470	All to Italy.
Kaolin	4,765	7,668	Italy 6,239; Greece 1,426.
Products:			
Refractory (including nonclay brick)	149,952	94,072	Romania 29,127; Poland 20,740; U.S.S.R. 17,674; West Germany 16,053.
Nonrefractory	635	2,288	Austria 928; East Germany 354; West Germany 268.
Feldspar	r10,483	6,974	Hungary 3,300; Greece 2,736; Czechoslovakia 898.

See footnotes at end of table.

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Table 2.—Yugoslavia: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Fertilizer materials, manufactured:			
Nitrogenous	5,521	38,466	West Germany 20,312; Turkey 10,000; Netherlands 5,163.
Phosphatic	16,744	134,876	Hungary 107,075; East Germany 27,800.
Other, including mixed	157,219	159,247	Italy 58,781; Hungary 35,777; West Germany 26,632; Ghana 14,820.
Gypsum and plaster	18	12	Gabon 5; U.S.S.R. 4; Sudan 3.
Lime	743	3,862	United Kingdom 2,156; Hungary 1,646.
Magnesite	69,599	34,715	Poland 12,831; U.S.S.R. 10,070; Italy 8,584.
Pyrite, gross weight	171,920	209,015	Romania 196,153.
Salt and brine	51	1	All to Austria.
Sodium and potassium compounds, n.e.s	16,071	1,081	U.S.S.R. 1,020.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	61,400	50,853	Italy 30,079; Czechoslovakia 11,850.
Worked	10,450	11,202	West Germany 7,875.
Dolomite, chiefly refractory grade	196	356	France 291; Greece 50.
Gravel and crushed rock	1,902	72,000	Mainly to Gabon.
Limestone (except dimension)	146	986	Do.
Quartz and quartzite	21,049	11,647	All to West Germany.
Sand, excluding metal bearing	2,198	1,444	Albania 1,259; Greece 177.
Sulfur:			
Sulfur dioxide	5	--	
Sulfuric acid	19,819	5,104	Mainly to Romania.
Talc, steatite, soapstone, pyrophyllite	22	11	Czechoslovakia 10; West Germany 1.
Other:			
Crude:			
Calcite	NA	145	Pakistan 124; West Germany 21.
Unspecified	1,071	1,325	Mainly to Greece.
Slag, dross, and similar waste, not metal bearing	5,044	1,375	Austria 799; Italy 575.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	503	223	All to West Germany.
Coal and briquets:			
Anthracite and bituminous coal	10,149	146	All to Austria.
Lignite and lignite briquets	339,068	355,163	Austria 212,623; Italy 42,525.
Hydrogen, helium, rare gases ____ kilograms	100	27,920	Italy 17,920; Iran 10,000.
Peat, including peat briquets and litter	22	NA	
Petroleum:			
Partly refined ___ thousand 42-gallon barrels	28	NA	
Refinery products:			
Gasoline ____ do	44	512	Netherlands 437.
Kerosine and jet fuel ____ do	288	253	United Kingdom 55; Austria 40.
Distillate fuel oil ____ do	r299	923	West Germany 379; Italy 210; Austria 191.
Residual fuel oil ____ do	396	200	Austria 31; Brazil 30; Liberia 30.
Lubricants ____ do	1	5	Bulgaria 1.
Other:			
Liquefied petroleum gas ____ do	104	(1)	NA
White spirits ____ do	4	35	All to Austria.
Mineral jelly and wax ____ do	NA	42	Italy 24; West Germany 10.
Petroleum coke ____ do	5	62	All to West Germany.
Unspecified ____ do	1	--	
Total ____ do	1,142	2,032	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	820	6,422	Belgium-Luxembourg 2,871; Netherlands 1,931; Italy 902.

rRevised. NA Not available.
1Less than 1/2 unit.

Table 3.—Yugoslavia: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite and concentrate ____ thousand tons	109	41	Greece 25; Australia 7; People's Republic of China 4.
Alumina	523	1	All from United States.
Oxide and hydroxide	174,490	38,352	Guinea 35,734.
Metal including alloys:			
Unwrought	32,331	33,684	U.S.S.R. 29,185.
Semimanufactures	16,227	12,073	U.S.S.R. 4,416; West Germany 3,028; Switzerland 1,263.

See footnotes at end of table.

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Table 3.—Yugoslavia: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Antimony:			
Ore and concentrate	3,276	1,935	Turkey 893; Morocco 854.
Metal including alloys, all forms	127	118	People's Republic of China 68; Japan 40.
Arsenic:			
Trioxide, pentoxide, acids	49	111	U.S.S.R. 55; West Germany 40; France 13.
Metal including alloys, all forms	25	18	Sweden 15; West Germany 3.
Beryllium metal including alloys, all forms kilograms	121	52	Mainly from Denmark.
Bismuth metal including alloys, all forms	4	24	Belgium-Luxembourg 16; Hungary 8.
Cadmium metal including alloys, all forms	4	1	All from Italy.
Chromium:			
Chromite	224,809	184,334	U.S.S.R. 72,594; Albania 70,998; Turkey 28,211.
Oxide and hydroxide	535	332	U.S.S.R. 200; Hungary 113.
Metal including alloys, all forms	14	12	West Germany 11.
Cobalt:			
Oxide and hydroxide	19	19	Belgium-Luxembourg 10; West Germany 6.
Metal including alloys, all forms	41	83	Belgium-Luxembourg 69; Zaire 8.
Columbium and tantalum: Tantalum metal including alloys, all forms kilograms	590	364	West Germany 162; United States 100; Austria 79.
Copper:			
Ore and concentrate	9,991	30,701	Philippines 21,912; Chile 8,789.
Copper sulfate	685	1,536	All from U.S.S.R.
Metal including alloys:			
Scrap	NA	8	All from West Germany.
Unwrought	37,541	31,812	Zambia 17,699; Chile 9,328.
Semimanufactures	7,744	6,461	U.S.S.R. 1,971; West Germany 1,437; Chile 1,285.
Germanium metal including alloys, all forms kilograms	71	2	All from United Kingdom.
Iron and steel:			
Ore and concentrate	597,924	481,892	Brazil 265,787; U.S.S.R. 101,690; Peru 88,000.
Metal:			
Scrap	346,398	341,841	U.S.S.R. 195,407; Bulgaria 79,490.
Pig iron, including cast iron	95,217	140,248	U.S.S.R. 44,592; North Korea 33,001; East Germany 23,804; India 19,771.
Sponge iron, powder, shot	9,293	1,690	Sweden 1,592.
Ferroalloys:			
Ferromanganese	1,801	998	West Germany 927.
Other	5,785	1,394	West Germany 1,198.
Steel, primary forms:			
Blooms, billets, slabs, sheets, bars	393,697	401,647	U.S.S.R. 139,320; Czechoslovakia 109,216; East Germany 77,091; Romania 47,782.
Coils for recoiling	478,273	189,630	U.S.S.R. 63,780; Czechoslovakia 62,503; Bulgaria 26,389; Japan 24,917.
Semimanufactures:			
Bars, rods, angles, shapes, sections	513,674	294,912	Czechoslovakia 109,382; U.S.S.R. 42,680.
Universals, plates, sheets	495,795	409,300	Czechoslovakia 95,694; West Germany 60,135; Japan 49,634; Austria 43,495.
Hoop and strip	137,836	85,646	West Germany 25,329; Poland 22,134; Czechoslovakia 12,962.
Rails and accessories	16,516	5,600	U.S.S.R. 1,895; West Germany 1,857; Austria 722; Italy 586.
Wire	81,144	117,957	Kuwait 30,026; West Germany 22,907; East Germany 20,558.
Castings and forgings, rough	1,225	1,015	West Germany 396; Italy 195; Belgium-Luxembourg 161.
Lead:			
Ore and concentrate	20,106	8,123	Greece 6,688; Italy 1,435.
Oxides	924	1,391	Poland 500; West Germany 360; Bulgaria 316; Austria 203.
Metal including alloys:			
Scrap	3,130	938	Switzerland 454; West Germany 155; Nigeria 130; Liberia 100.
Unwrought	15,800	3,824	Bulgaria 3,076; Zambia 600.
Semimanufactures	36	51	West Germany 49.
Magnesium metal including alloys, all forms	825	887	U.S.S.R. 502; United States 118.
Manganese:			
Ore and concentrate	77,610	101,683	U.S.S.R. 29,480; Gabon 28,924; Swaziland 28,849.
Oxides	1,408	937	West Germany 281; Gabon 260; Greece 120.
Metal	353	318	Sweden 100; Japan 81; West Germany 52; Switzerland 40.
Mercury 76-pound flasks	1,682	435	All from West Germany.
Molybdenum metal including alloys, all forms	16	11	Austria 7.
Nickel metal including alloys:			
Scrap	3	--	
Matte, speiss, similar materials	NA	8	All from United Kingdom.
Unwrought	170	1,207	U.S.S.R. 505; United Kingdom 118.
Semimanufactures	635	707	West Germany 410.

See footnotes at end of table.

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Table 3.—Yugoslavia: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Platinum-group metals including alloys, all forms:			
Platinum ---------- troy ounces	1,511	4,372	U.S.S.R. 1,736; West Germany 1,254; United Kingdom 900.
Palladium ---------- do	30,896	53,306	Mainly from U.S.S.R.
Rhodium ---------- do	32	--	
Other ---------- do	1,961	--	
Silver metal including alloys thousand troy ounces	1,789	1,318	West Germany 418; Austria 322; Switzerland 289; Poland 161.
Tellurium, elemental ---------- kilograms	316	300	All from West Germany.
Tin:			
Oxides ----------	6	4	Do.
Metal including alloys:			
Unwrought ----------	1,038	1,365	Malaysia 687; People's Republic of China 571.
Semimanufactures ----------	20	17	West Germany 11.
Titanium:			
Ore and concentrate ----------	52,069	45,093	All from Australia.
Oxides ----------	2,932	2,419	Hungary 695; West Germany 563; France 398; Czechoslovakia 340; United Kingdom 286.
Metal including alloys, all forms ----------	113	23	United States 15; West Germany 2; U.S.S.R. 2.
Tungsten metal including alloys, all forms ----------	9	11	Austria 3; Netherlands 2; United Kingdom 2; France 1.
Zinc:			
Ore and concentrate ----------	58,046	67,891	North Korea 25,207; Peru 14,241; Canada 9,365; Czechoslovakia 8,821.
Oxides ----------	166	138	West Germany 130; United Kingdom 2.
Metal including alloys:			
Unwrought ----------	18,772	12,974	Zambia 9,101; Bulgaria 2,390; U.S.S.R. 1,456.
Semimanufactures ----------	298	187	West Germany 138; Italy 49.
Zirconium metal including alloys, all forms ----------	4	(1)	NA.
Other:			
Ores and concentrates:			
Of vanadium, tantalum, zirconium ----------	363	752	Australia 244; Netherlands 220; West Germany 182.
Of base metals, n.e.s ----------	3,276	--	
Ash and residue containing nonferrous metals --	55	220	Mainly from Switzerland.
Oxides, hydroxides, peroxides of metals, n.e.s ---	707	797	West Germany 571.
Metals including alloys, all forms:			
Metalloids ----------	186	142	West Germany 70; U.S.S.R. 55.
Alkali, alkaline earth, rare-earth metals ---	291	191	France 108; Italy 44; West Germany 30.
Pyrophoric alloys ----------	10	8	Austria 2; West Germany 1; Italy 1.
Base metals including alloys, all forms, n.e.s.	35	29	United Kingdom 23; Belgium-Luxembourg 5.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc ----------	229	236	Denmark 138; Italy 46; Netherlands 25.
Grinding and polishing wheels and stones -----	1,634	1,100	Austria 606; West Germany 188; Italy 124.
Asbestos ----------	52,138	42,675	U.S.S.R. 30,405; Botswana 6,137; Canada 4,845.
Barite and witherite ----------	1,393	760	West Germany 580; Czechoslovakia 180.
Boron materials:			
Crude natural borates ----------	20,057	14,465	United States 13,465.
Oxides and acids ----------	1,519	1,002	U.S.S.R. 811; France 152.
Bromine ----------	6	2	All from Austria.
Cement:			
Portland ---------- thousand tons	r340	255	Hungary 205.
Other ---------- do	139	325	Italy 92; Austria 26.
Chalk ----------	2,388	2,230	France 1,518; Austria 528.
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite ----------	424	343	Italy 250; West Germany 40; United Kingdom 37.
Fire clay ----------	18,212	22,416	Czechoslovakia 19,190.
Fuller's earth, Dinas earth, chamotte -----	2,830	5,103	Poland 2,026; West Germany 1,767; Czechoslovakia 945.
Kaolin ----------	59,528	60,389	Czechoslovakia 34,692; West Germany 9,457; Greece 7,084.
Other ----------	4,496	4,682	Czechoslovakia 3,690.
Products:			
Refractory (including nonclay brick) -----	27,960	55,989	U.S.S.R. 20,320; West Germany 14,195; Austria 7,213.
Nonrefractory ----------	68,260	32,776	Italy 10,032; Albania 6,156; Romania 5,332; Czechoslovakia 4,682.
Cryolite and chiolite ----------	360	448	All from Denmark.
Diamond:			
Gem, not set or strung ---------- carats	15,000	15,000	West Germany 10,000.
Industrial ---------- do	65,000	535,000	United Kingdom 295,000; France 100,000; Belgium-Luxembourg 70,000.
Powder ---------- do	70,000	345,000	U.S.S.R. 185,000; United Kingdom 70,000; Switzerland 65,000.

See footnotes at end of table.

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Table 3.—Yugoslavia: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Diatomite and other infusorial earth	148	145	Austria 65; Hungary 60.
Feldspar	1,070	629	France 600.
Fertilizer materials:			
Crude, phosphatic thousand tons	846	880	Morocco 692; Togo 126.
Manufactured:			
Nitrogenous	157,585	129,708	Hungary 40,528; Czechoslovakia 34,598; U.S.S.R. 33,874; Poland 16,018.
Phosphatic	43,927	39,881	Tunisia 28,940; Morocco 10,000.
Potassic	247,385	333,017	East Germany 208,602; U.S.S.R. 114,979.
Other, including mixed	14,419	20,064	Poland 14,624; Romania 4,999.
Ammonia	39,276	64,284	Hungary 45,214; East Germany 11,557; U.S.S.R. 7,507.
Fluorspar	6,638	5,617	East Germany 2,937; West Germany 1,826; France 601.
Graphite, natural	1,569	1,853	Austria 652; U.S.S.R. 472; Czechoslovakia 372; East Germany 200.
Gypsum and plasters	7,712	5,179	Mainly from Poland.
Iodine	50	38	Poland 23; Japan 8; United States 7.
Lime	476	--	
Magnesite	12,221	17,788	Turkey 9,695; North Korea 6,986.
Mica:			
Crude, including splittings and waste	396	314	Norway 234; West Germany 40.
Worked, including agglomerated splittings	323	101	Czechoslovakia 24; India 19; Austria 17; West Germany 16; Belgium-Luxembourg 14.
Pigments, mineral:			
Natural, crude	7	--	
Iron oxides, processed	2,932	2,103	Hungary 787; West Germany 691; Czechoslovakia 312; Spain 255.
Precious and semiprecious stones, except diamond:			
Natural kilograms	29	17	West Germany 13; India 3.
Manufactured do	410	244	Japan 117; Switzerland 61; West Germany 60.
Pyrite, gross weight	101,310	11,990	Mainly from U.S.S.R.
Quartz, piezoelectric kilograms	564	2,019	Mainly from United States.
Salt and brine	113,247	141,760	Romania 105,153; Tunisia 30,000.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	115,922	109,698	Italy 48,919; France 30,703; West Germany 21,369.
Caustic potash and sodic and potassic peroxides	2,006	1,134	Czechoslovakia 386; East Germany 305; West Germany 273.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	4,208	6,993	Greece 6,051; Italy 917.
Slate	326	207	West Germany 180; France 20.
Other	2,480	1,965	Italy 1,773.
Worked:			
Slate	37	200	All from Italy.
Other	25	234	Mainly from Italy.
Dolomite, chiefly refractory grade	4,409	1,791	Italy 1,176; Austria 545.
Gravel and crushed rock	143,371	148,129	Mainly from Hungary.
Limestone (except dimension)	40,202	35,375	All from Hungary.
Quartz and quartzite	16,031	108,219	East Germany 19,353; Hungary 17,112.
Sulfur:			
Elemental, all forms	1,832	204	West Germany 130; Italy 74.
Sulfur dioxide	80	441	Italy 250; West Germany 191.
Sulfuric acid	155,110	52,590	Hungary 24,732; Bulgaria 8,776; East Germany 6,012.
Talc, steatite, soapstone, pyrophyllite	2,488	2,461	France 978; Italy 702; West Germany 330.
Other:			
Crude	10,947	9,716	Hungary 8,094; Austria 1,295.
Slag, dross, and similar waste, not metal bearing	298,762	200,112	Mainly from Italy.
Oxides and hydroxides of magnesium, strontium, barium	506	1,473	Norway 1,000; West Germany 289.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	3,686	5,414	Romania 4,579; Albania 794.
Carbon black and gas carbon	7,976	6,612	Italy 4,820; West Germany 992.
Coal and briquets:			
Anthracite and bituminous coal thousand tons	2,176	2,688	U.S.S.R. 1,750; Czechoslovakia 658.
Briquets of anthracite and bituminous coal	NA	486	All from Poland.
Lignite and lignite briquets	155,855	127,519	U.S.S.R. 54,164; East Germany 37,768; Greece 13,053.
Coke and semicoke thousand tons	499	170	Poland 100; Italy 31; United Kingdom 18.
Hydrogen, helium, rare gases kilograms	24,147	12,498	Italy 8,797; West Germany 1,703; Austria 1,300.
Peat, including peat briquets and litter	8,114	5,637	U.S.S.R. 3,640; Hungary 979; Poland 908.
Petroleum:			
Crude thousand 42-gallon barrels	51,779	58,058	Iraq 33,556; U.S.S.R. 21,343.
Partly refined do	126	140	Italy 50; Hungary 39; West Germany 18; Czechoslovakia 17.

See footnotes at end of table.

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Table 3.—Yugoslavia: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum —Continued			
Refinery products:			
Gasoline ---do---	94	70	Italy 36; Netherlands 32.
Kerosine and jet fuel ---do---	2	6	U.S.S.R. 4.
Distillate fuel oil ---do---	3,088	2,590	All from U.S.S.R.
Residual fuel oil ---do---	2,171	2,116	U.S.S.R. 1,981.
Lubricants ---do---	147	192	West Germany 43; Netherlands 25; United Kingdom 25; Italy 23; U.S.S.R. 20.
Other:			
Liquefied petroleum gas ---do---	r516	633	Bulgaria 94; Czechoslovakia 68.
Mineral jelly and wax ---do---	5	33	East Germany 9; Hungary 9; West Germany 5; Bulgaria 4.
Nonlubricating oils, n.e.s ---do---	119	271	Romania 57; Bulgaria 47; Czechoslovakia 45; Italy 35; U.S.S.R. 35.
Bitumen and other residues, n.e.s ---do---	303	220	Albania 169; Hungary 37.
Bituminous mixtures, n.e.s ---do---	18	21	Italy 13; West Germany 4.
Pitch ---do---	88	60	West Germany 50; Italy 10.
Petroleum and pitch coke ---do---	484	350	United States 208; West Germany 68; U.S.S.R. 40.
Total ---do---	r7,035	6,562	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	58,975	29,595	U.S.S.R. 10,120; Poland 7,836; Austria 3,660; Hungary 2,969.

rRevised. NA Not available.
[1]Less than 1/2 unit.

Table 4.—Yugoslavia: Mineral trade with the United States, 1976[1]

Commodity	Exports		Imports	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
METALS				
Aluminum metal including alloys	25,614	$23,787	159	$543
Copper metal including alloys	47,083	62,163	163	516
Iron and steel metal:				
Scrap	--	--	25,248	1,890
Ferroalloys	38,289	16,589	--	--
Semimanufactures:				
Bars and angles	--	--	36	108
Plates and sheets	--	--	58	162
Hoop and strip	--	--	22	20
Rails	--	--	115	27
Wire	--	--	491	729
Tubes and pipes	5,776	1,977	2,611	5,991
Castings and forgings	260	217	4	49
Lead metal including alloys	18,095	6,576	--	--
Mercury	232	658	--	--
Nickel metal including alloys	--	--	147	434
Platinum-group metals	NA	356	--	--
Radioactive and associated materials	--	--	2	82
Silver metal including alloys	100	10,634	--	--
Uranium metal including alloys	--	--	(2)	6
Zinc metal including alloys	27,146	19,699	--	--
Other base metals including alloys	3,351	4,108	26	1,073
NONMETALS				
Cement	2,109	170	--	--
Clays and refractory materials	--	--	1,797	204
Diamond, gem, and precious stones	--	--	5	45
Stone, sand and gravel	--	--	65	7
Other, crude	3	10	--	--
MINERAL FUELS AND RELATED MATERIALS				
Coal, all types	18	1	166,860	9,758
Petroleum refinery products:				
Lubricants	--	--	262	599
Petroleum coke, asphalt, etc	16,163	1,801	28,088	4,047
Total	XX	148,746	XX	26,290

NA Not available. XX Not applicable.
[1]Data may disagree with that reported elsewhere in this chapter owing to a difference in source.
[2]Less than 1/2 unit.

Source: U.S. Department of Commerce, Bureau of the Census.

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COMMODITY REVIEW

METALS

Aluminum.—The beginning of construction of an aluminum smelter at Bacevici near Mostar, Bosnia and Hercegovina; continuation of construction of alumina plants at Birac, near Zvornik, Bosnia and Hercegovina, and near Obrovac, Croatia; and credit from the German Democratic Republic for expansion of an aluminum plant near Sibenik, Croatia, were the most important events related to the aluminum industry of Yugoslavia during 1977.

Construction of the new 92,000-ton-per-year aluminum electrolytic plant at Bacevici, to cost 4 billion dinars (Din), started during July 1977. The new plant is located near the existing 280,000-ton-per-year alumina plant. Foreign equipment suppliers will furnish 11% of the equipment. The State-owned concern Energoinvest, the major investor, will operate the plant after completion in 1980.[4] The Bacevici plant, also known as the Mostar plant, has a long history. The decision to build the plant was made in 1972. The beginning of construction was marked with a ceremony in 1973. From 1973 until fall 1977, construction was delayed by financial problems. In 1977, Péchiney Ugine Kuhlmann (PUK) agreed to provide know-how and financial support. With PUK's backing, actual plant construction started in fall 1977, with completion scheduled within 30 months.

Construction continued on a 600,000-ton-per-year alumina plant at Birac, also known as the Zvornik plant. The U.S.S.R. was financing construction, and credit was to be repaid within 10 years with deliveries of all alumina produced at Birac. In addition, construction continued on the alumina plant near Obrovac, Croatia. The annual capacity was reported to be 300,000 tons of alumina. Startup for both alumina plants was scheduled for mid-1978.

The Government of the German Democratic Republic agreed to finance construction for 35,000 tons of additional aluminum capacity at the Sibenik aluminum plant. Completion of the expansion was scheduled for 1981, when the Sibenik facility should have a capacity of 110,000 tons of aluminum per year. The Sibenik aluminum plant remained the largest producer of aluminum metal in the country, and based on preliminary reports, produced a record high of 82,000 tons of aluminum metal during 1977. Despite excellent production results, the enterprise sustained a financial loss of about Din150 million, resulting from domestic sales at fixed prices and from artificial exchange rates for foreign currencies earned from exports.

Yugoslavia was a net exporter of bauxite and aluminum metal. Apparent consumption of aluminum metal was about 92,000 tons in 1976, the latest year for which complete data are available.

Antimony.—After about 12 months of trial production, the Rajiceva Gora antimony mine and mill on Kopaonik Mountain in Serbia, operated by Rudarsko Topionicarski Basen Zajaca (RTB Zajaca), started regular production. Output should reach 300,000 tons of ore by 1979. Reserves of antimony ore at Rajiceva Gora were estimated at between 10 million and 15 million tons. The grade of the ore was not made public.

Exploration in the general area of Rujevac, Serbia, led to the discovery of "important" reserves of lead, zinc, and antimony ores. Development of a new mine was to start during 1979, provided that financing was assured. In the vicinity of Kriva Palanka, Serbia, exploration for bentonite by geologists of Bentomak, a local producer of bentonite, led to the discovery of antimony ore. During exploration work, about 13,000 tons of ore was produced; it was considered that the deposit could justify construction of a mine and mill.

A decision to build Yugoslavia's first antimony oxide plant, initially of 400-ton-per-year capacity, was made by RTB Zajaca. The location of the facility was not announced, but it is believed that it will be Zajaca, where the only Yugoslav antimony smelter was in operation.

Copper.—Although economic results were below expectations, 1977 was an eventful year for the copper industry.

Development was completed of ore body X at the mine at Bor, Serbia, operated by Rudarsko Topionicarski Basen Bor (RTB Bor), the only mine and smelter producer of copper in Yugoslavia, and trial production started in 1977. Reserves of 8 million tons of ore with an average metal content of 1.1% copper were confirmed. In addition, RTB Bor decided to start development of a new opencast copper mine at Veliki Krivelj, and the beginning of actual development was scheduled for 1978. The first phase of development was scheduled for completion in 1980, when the Veliki Krivelj mine should

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produce 25,000 tons of copper in concentrate. The average ore grade was only 0.42% copper, but according to the management, it is "easy" to concentrate.[5]

For the Veliki Krivelj operation, RTB Bor was planning to purchase 12 trucks of 120- to 150-ton capacity and two 11-cubic-meter shovels and to build a flotation plant with an annual capacity of 5.5 million tons of ore.[6] It was expected that when development is completed after 1980, the Veliki Krivelj operation would have an annual capacity of 64,000 tons of copper in concentrate, including production from a small rich deposit at nearby Cerovo.

At Majdanpek, Serbia, also in the general area of Bor, work continued on construction of another segment of the mill. When completed early in 1978, the mill will have a capacity of over 14 million tons per year of ore. During 1977, the opencast mine at Majdanpek produced about 13.3 million tons of ore, from which the flotation plant produced about 258,000 tons of concentrates containing about 64,500 tons of copper. Approximately 33 million tons of overburden was removed. At yearend, the Majdanpek mine employed about 3,020 persons.

At Bucim, Macedonia, near Radovis, development of a mine and construction of a mill continued by a Macedonian State enterprise, Bucim Rudnik za Bakar u Osnivanju. Recent exploration confirmed 100 million tons of ore. Reportedly, the ore grade is such that it could sustain an output of 22,000 tons of copper per year for 28 years. First concentrates from Bucim should be shipped to the Bor smelter during 1978.

Iron Ore.—Exploration and production of iron ore remained concentrated in areas already known as producers of iron ore in Bosnia and parts of western Macedonia. Difficulties were encountered in financing exploration for iron ore and development of new mining capacities of over 9 million tons of ore per year to become operational in 1980.

Iron mines in Bosnia, of which the Vares-Ljubija mines operated by Rudarsko-Metalurski Kombinat Zenica (RMK Zenica) are the most important, remained the largest producers of iron ore in the country, accounting for about 82% of total output.

Domestic production of iron ore supplied slightly under 89% of the country's demand, and Yugoslavia was a net importer of iron ore. Brazil and the U.S.S.R. were the principal suppliers. Apparent consumption of iron ore was about 4.7 million tons in 1976, the latest year for which complete data are available.

Iron and Steel.—The RMK Zenica plant at Zenica, Bosnia and Hercegovina, the largest integrated iron and steel plant in the country, continued to expand its facilities. After trial production, which started in August 1976, a new Soviet-built converter steel plant went into regular production during summer 1977 at a lower output than the capacity of 1.3 million tons of steel per year. The Zenica plant's new total annual capacity of 2.3 million tons of steel can only be reached after completion of the fourth blast furnace designed to produce 1 million tons of pig iron per year. The blast furnace was scheduled for completion in 1978 or 1979.

At the Smederevo iron and steel plant, a hot-rolling installation was completed with a capacity of 220,000 tons of hot-rolled strip, whereupon the first phase of construction, which lasted 13 years, was completed. A second expansion project was started in 1977, which is to increase output to 1.6 million tons of steel.

Lead and Zinc.—Exploration for new lead and zinc deposits and expansion of several mines, the lead refinery at Zvecan, Serbia, and the zinc electrolytic plants at Sabac and Kosovska Mitrovica, both in Serbia, were the principal activities in the lead and zinc industry during 1977. Lead and zinc smelter capacities remained greatly in excess of mine production, and imports of zinc concentrates were an important part of the smelter supply.

Montenegro, particularly the northern part, was the site of active exploration for lead and zinc and other minerals, although no major discoveries in that area were made public during 1977. The recently completed railroad line from Beograd to the port of Bar on the Adriatic Sea, passing through northern Montenegro, encouraged exploration in that area.

At the Stari Trg mine, operated by Rudarsko-Metalurski Kombinat Trepca (RMK Trepca), development of 10 and 11 Horizon and construction of a new mill at Tunnel 1 continued during 1977. When completed sometime around 1980, the Stari Trg mine should produce and process 1 million tons of ore per year, an increase of about 40% over the 1977 output.

At the Rudnik mine in Serbia, expansion of capacity started. When completed in 1978, output of ore should increase to 230,000 tons, about 60,000 tons more than present production. Costs of expansion were reported at Din100 million (about $5 million).

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Preliminary work for expansion of the zinc electrolytic plants at Sabac, operated by Hemiska Industrija Zorka, and Kosovska Mitrovica, operated by RMK Trepca, was underway. The new capacity at Sabac was planned at 48,000 tons per year and at Kosovska Mitrovica, 65,000 to 70,000 tons per year.

RMK Trepca remained the largest mine and smelter producer of lead and zinc in the country. Among other facilities, RMK Trepca operated the country's largest lead and zinc mine at Stari Trg (also known as the Trepca mine), the largest lead smelter and refinery at Zvecan (also known as the Trepca smelter), and the largest zinc electrolytic plant at Kosovska Mitrovica (also known as the Trepca zinc electrolytic plant).

During 1977, about 18 lead-zinc mines and 14 flotation plants were operational. Two lead smelters, one at Zvecan, Serbia, and the other at Mezica, Slovenia, and one lead refinery at Zvecan produced lead. In addition, one Imperial smelting plant at Titov Veles, Macedonia, produced lead and zinc, and two zinc electrolytic plants, one at Sabac, Serbia, and the other near Kosovska Mitrovica, Serbia, were in production.

Mercury.—The mine and smelter at Idria, Slovenia, the only mercury producer in Yugoslavia, was closed at the beginning of 1977 because of low mercury prices. The mine and smelter retained a maintenance crew to keep facilities operational in order to restart the operation whenever the price for mercury on the world market assures a profitable operation.

Nickel.—Development of a mine and construction of a ferronickel smelter continued during 1977 at Rzanovo, near Kavadarci, Macedonia. Reserves in the area are put at about 30 million tons of lateritic ore containing 0.9% nickel. Production should start in 1978 or 1979. Mine output reportedly will be 2 million tons per year and the smelter should reach an annual output of 64,000 tons of ferronickel containing about 16,000 tons of nickel. The main equipment for this nickel ore-pelletizing plant is to be supplied by Polysius Corp. of Atlanta, Ga. The pelletizing plant will consist of five pelletizing discs with diameters of 7.6 meters and two Lepol kiln lines with a traveling grate system. Each kiln is 6.0 meters in diameter and 75 meters long. The Lepol grates are 4.0 meters wide and 42 meters long. Each line should produce 2,400 tons per day of prereduced pellets with a metal content averaging about 5.5%. The combination of rotary kiln and electric furnace lowers the production costs because the efficiency of the process is improved by using hot prereduced pellets. This plant uses, for the first time, a combined pelletizing and prereduction process for nickel ore.[7]

The major bulk materials-handling equipment contract went to Robins Engineers & Constructors. The contract was for the design, supply, and commissioning of a sloping and luffing boom stacker and two portal scraper reclaimers. The stacker was designed to build two parallel storage piles at a rate of 715 tons per hour. Each portal scraper will reclaim the layered ore at a rate of 375 tons per hour and mix the stored ore for delivery to the smelter. To prevent pollution of the area near the nickel smelter, Environmental Elements Corp. (Enelco) of the United States supplied a complete wet-scrubbing system for each of two ferronickel electric furnaces. The scrubbing systems incorporate adjustable-throat Venturi scrubbers, four stainless steel fans, four quench towers, and interconnecting refractory-lined and stainless steel ducts.

Other.—Yugoslavia also produced bismuth, cadmium, chromite, germanium, gold, manganese, platinum, palladium, selenium, and silver in 1977. Bismuth was a byproduct of lead and zinc at RMK Trepca's smelter in Serbia, and cadmium was a byproduct of RMK Trepca's smelter, Hemiska Industrija Zorka's zinc electrolytic plant at Sabac, Serbia, and the lead-zinc smelter at Titov Veles, Macedonia. The Bor complex in Serbia yielded gold, germanium, platinum, palladium, and selenium as byproducts of copper. Manganese was produced in Bosnia. RMK Trepca's operations were the main source of silver, a byproduct of lead and zinc processing.

NONMETALS

Bentonite.—The local authorities at Vlasotince, Serbia, and the Foundry and Metallurgical Combine of Beograd signed an agreement for development of bentonite deposits near the villages of Ladovica, Prisjan, and Zavidince. A plant for processing bentonite will be built at Vlasotince. Most of the bentonite produced is to be used by the Combine.

Cement.—During 1977, one new cement plant with a capacity of 1.2 million tons came onstream at Beocin near Novi Sad, Serbia. Total investment at Beocin reached an equivalent of $105 million. Construction also continued on a 600,000-ton-per-year cement plant at Kakanj, Bosnia and Herce-

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govina, and on an addition with a capacity of 600,000 tons per year at the existing plant at General Jankovic in Macedonia. Both plants should start normal production during 1979.

Output of cement ranked first in value of nonmetals produced in Yugoslavia and reached an alltime high of 8 million tons in 1977, but domestic production was, nevertheless, below requirements and imports were necessary. Twenty cement plants were in operation, the largest of which was a 1,750,000-ton-per-year plant at Beocin, operated by Beocinska Fabrika Cementa.

Lime.—During 1977, construction continued on a 100,000-ton-per-year lime plant at Drnis, Croatia, and all preliminary work was completed for construction of a 125,000-ton-per-year hydrated lime plant at Slavonski Brod, Croatia. In addition, production of lime for metallurgical use started at the Veljko Dugosevic lime plant at Kucevo, Serbia. Reportedly, all output will be used by the iron and steel works at Smederevo, Serbia.

Magnesite.—After long debate, local authorities at Bar, Montenegro, a port on the Adriatic Sea, granted conditional permission for construction of an installation to produce sinter magnesite from seawater and dolomite. Strict protection of the environment was reported as the basic condition for making the project a reality. How Magnohrom, the investor for the project, will react to this condition was not known at yearend.

Salt.—The Bajo Sekulic marine salt plant at Ulcinj, Montenegro, completed planning for construction of a salt refinery with a capacity of 240 tons per day. Equipment was purchased in Italy. The refinery should start operation in 1979.

Silicon.—A new quartzite mine operated by a local enterprise came onstream in the village of Donja Bela Reka near Bor, Serbia. Reserves were set at 50 million tons of quartzite with a purity of 99.28%.

MINERAL FUELS

During 1977, domestic low-rank coals remained the principal source of energy in the country, and Yugoslavia was dependent on imports of high-rank coals, coke, and crude oil. Table 5 shows supply and apparent consumption of energy-producing materials for 1975 and 1976, in million tons of standard coal equivalent.

A decision to build, jointly with Romania, another hydroelectric plant at Djerdap on the Dunav (or Danube) River, 80 kilometers below the existing dam at Iron Gates, will assure a regular supply of electric power to the copper mines and smelter and electrolytic plants in eastern Serbia. The powerplant will consist of 16 hydroturbines with an installed capacity of 432 megawatts. The planned completion date is 1985.

Coal.—In the Kolubara basin, approximately 60 kilometers southwest of Beograd, the enterprise Rudarsko Energetsko Industrijski Kombinat Kolubara (REK Kolubara) started development of the Tamnava opencast mine in Serbia. Plans called for an output of 18 million to 20 million tons of lignite to be reached sometime between 1980 and 1985. The lignite is low grade; an average analysis showed a moisture content of around 50%, ash 10%, and sulfur about 0.5%, with a calorific value of between 1,800 and 2,200 kilocalories per kilogram. Most of the production will be used by several powerplants situated near Obrenovac. Long-range targets for the Tamnava project include operation of five lignite-fired powerplants with a total capacity of 6,700 megawatts-electric, based on an output of 40 million tons of lignite.

In the Kosovo lignite basin near Pristina, Serbia, Rudarsko Energetsko Hemijski Kombinat Kosovo (REH Kosovo) started work on construction of two power-generating units with capacities of 339 megawatts each near Obilic. The Belacevac opencast mine in the Kosovo basin, located nearby, will supply the necessary lignite to meet future demand. Work was started on expanding the Belacevac mining field production from 5.5 million tons to 10 million tons and completing mine expansion and construction of powerplants.

Long-range plans announced late in 1977 indicated the development of the Sisovac opencast mine, also in the Kosovo basin, with an annual capacity of 18 million tons of lignite. The Sisovac mine was planned to supply lignite to three new electric powerplants with a capacity of 600 megawatts each planned for the region after 1980. When all planned powerplants are completed, the area around Pristina, Serbia, will have in operation nine lignite-fired power-generating units, with an aggregate capacity of 3,200 megawatts. Concern was expressed about the environmental impact on the Kosovo region of burning such large quantities of lignite and handling cinder and ashes from plants. REH Kosovo awarded a contract to a Swiss firm, Laufenburg, for an overall study on all aspects of the effects that this project may have.[8]

In 1977, the operating enterprise REH Kosovo had a capacity of 9.5 million tons of

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lignite, 1.2 million tons of dried lignite, and 400 million cubic meters of manufactured gas from lignite, and it operated five power-generating units with an aggregate capacity of 800 megawatts.

In Macedonia, work continued on development of lignite deposits in the locality of Suvodol in the Bitola basin. Exploration has confirmed reserves of about 300 million tons of lignite with an average calorific value of 1,800 kilocalories per kilogram. A new opencast mine was planned for production of between 2 million and 4 million tons of lignite per year. Two powerplants, Bitola I and Bitola II, with capacities of 210 megawatts each, will use lignite from Suvodol. Rudarsko-Energetski Kombinat Bitola managed the development of lignite mines during 1977 and will operate mines and powerplants when completed sometime between 1981 and 1983.

During 1977, the enterprise operating in the Kreka and Banovici basin, Titovi Rudnici Kreka-Banovici, was reorganized into four working organizations. The following tabulation shows the new organization and facilities operated by each organizational unit:

Organizational unit	Name of mine		Name of coal separation plant
	Open cast	Underground	
Rudnik Mrkog Uglja Djurdjevik	Visca	Djurdjevik	Djurdjevik.
Rudnici Lignita Kreka	Bukinje	Bukinje, Lipnica 1, Lipnica 2	--
Rudnik Mrkog Uglja Tito-Banovic	Cubric	Omazic	Omazic.
Rudnici Lignita Dobruja-Lukavac	Sicki Brod	Mramor and Lukavac	Mramor.

Plans announced during 1977 call for Titovi Rudnici Kreka-Banovici to increase its output of brown coal to 9.7 million tons in 1980. In addition, preliminary work started on opening three new opencast mines—Juzna, Sinklinala, Turija, and Sikulje. Aggregate capacity of these new mines was planned at 11.7 million tons per year after 1980.

Petroleum and Natural Gas.—During 1977, both petroleum and natural gas reached record high production—3.95 million tons of oil and 1,897 million cubic meters of natural gas. However, domestic crude oil production supplied only 28% of the Yugoslav refinery throughput in 1977. Imports from Iran, Iraq, and the U.S.S.R. were essential to meet the demand.

The natural gas supply and demand position was different from that of crude oil in Yugoslavia. Domestic output was more than adequate, and some of the natural gas had to be flared. However, the potential demand for natural gas in the country has not been developed because of a lack of gas pipeline systems, but when systems under construction in 1977 are completed and all potential demand becomes a reality, imports of natural gas will be necessary. Industrija Nafte (INA), headquartered in Zagreb, Croatia, and Naftagas, headquartered in Novi Sad, Serbia, remained the only producers of crude oil and natural gas and the most important processors of petroleum in Yugoslavia. INA was by far the largest, accounting for about 72% of the country's total crude oil output. During 1977, six refineries, three operated by INA (Rijeka, Sisak, and Lendava), two by Naftagas (Novi Sad and Pancevo), and one by Energoinvest (Bosanski Brod), had an installed annual capacity of 17.2 million tons, 4 million tons more than in 1976 because expansion at Rijeka was completed. In addition, four lubricant plants were operational in Yugoslavia during 1977 (Beograd, Maribor, Zagreb, and Krusevac).

Exploration, Development, Production.—About 300,000 meters of wells (both exploratory and development) were drilled in Yugoslavia during 1977, two-thirds of which were accounted for by INA. INA started exploration with its own semisubmersible offshore drilling rig on location along the Adriatic coast, opening a new era in the Yugoslav petroleum industry. However, the Pannonian Basin remained the principal area for active petroleum and natural gas exploration and development. INA started drilling with its own $40 million jackup rig, *Panon*, on June 2 at a site west of Zadar. After drilling one well with shows of gas, INA moved the rig north to the second site 35 miles southwest of the city of Pula. At this site, drilling revealed gas deposits which, according to preliminary testing, may be commercially significant. All other data on the well characteristics were apparently not made public. *Panon* is a jackup rig built in Rotterdam and constructed accord-

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Table 5.—Yugoslavia: Supply and apparent consumption of fuels and power for 1975 and 1976

(Million tons of standard coal equivalent[1])

	Total energy	Coal, all types, and coke	Petroleum and refinery products	Natural gas	Fuelwood	Hydro-electric power
1975:						
Production	r29.7	18.8	r5.4	2.3	0.6	2.6
Imports	15.1	2.8	12.3	(2)	(2)	(2)
Exports	.4	.1	.3	(2)	(2)	(2)
Apparent consumption	r44.4	21.5	r17.4	2.3	.6	2.6
1976:						
Production	31.0	19.6	5.7	2.5	.6	2.6
Imports	16.3	2.9	13.4	(2)	(2)	(2)
Exports	.7	.2	.5	(2)	(2)	(2)
Apparent consumption	46.6	22.3	18.6	2.5	.6	2.6

rRevised.
[1]1 ton standard coal equivalent (SCE)=7,000,000 kilocalories.
[2]Less than 1/2 unit.

ing to the latest state-of-the-art of construction of offshore rigs designed by Levingston Shipbuilding Co. of Texas. Maximum water depth for the new drilling rig is 94 meters, and the rig can drill wells 6,000 meters deep. After completing a series of about 25 exploratory wells in the Adriatic, and if all are dry, Yugoslavia plans to use *Panon* for operations outside the Adriatic.

In addition to drilling offshore, INA continued to drill onshore along the coast of the Adriatic. On the island of Brac, drilling started on an exploratory well planned to reach a depth of 6,000 meters. Drilling started in summer 1977, and at yearend there were no reports on the status of the well on Brac. In the Pannonian Basin, INA was joined by Naftagas in exploration for oil and gas. INA announced the discovery of a "rich" natural gas deposit at a depth of 4,000 meters at Obrovac near Slavonska Orahovica, Croatia. Exploration continued in the Drava River basin in the Peteranec area which, according to preliminary results, appears to be the largest field in the Drava River basin.

Naftagas conducted exploration in Vojvodina, a province of Serbia, and in Serbia proper. In Vojvodina, near Banatsko Veliko Selo near Kikinda, drilling started on an exploratory well with a target depth of 5,000 meters. Apparently, results of this drilling were not made public at yearend. Furthermore, Naftagas carried out a program of exploration in Serbia around the towns of Krusevac and Vranje. In the general area of Krusevac in the Zapadna Morava River Valley, mostly between Trstenik and Krusevac, two wells were drilled. In one well, located near the village of Stopanja, shows of oil and gas were found at a depth of 2,300 meters. In another well, in the vicinity of the village of Globoder, shows of gas were recorded at a depth of 1,500 meters. The economic significance of these oil and gas shows was not made public during 1977.

Near Vranje in southern Serbia, in an area starting at Bujanovac and ending at Vladicin Han, intensive geophysical exploration was underway at yearend. The aim of this exploration was to discover oil and gas; however, the area has a large number of hot springs, and it is hoped that exploration may lead to the possibility for development of geothermal energy.

INA, with a major crude oil field at Benicanci and a natural gas field at Boksic Lug, both in Croatia, and Naftagas, with its largest oil and gas fields near Kikinda, Serbia, remained the only producers of crude oil and natural gas in Yugoslavia. All producing fields were located in the Pannonian Basin.

Benicanci remained the largest operating oilfield in Yugoslavia, and during 1977 it produced about 1 million tons of crude oil or about 25% of the total output. Modernization of the pumping and collecting system was completed in the fall. With new equipment, the gathering system should have a capability to handle an additional 50,000 tons of oil per year, for a total of 1 million tons annually.

In the Coka oilfield near Coka in Banat, Vojvodina, construction started on an oil-collecting system. About 15 wells were completed, but exploration and development drilling continued at yearend. The size of future production at the Coka oilfield was not disclosed. In addition, Naftagas continued development work of oilfields near Mokrin and Palic, Vojvodina.

Refining.—Expansion of capacities of ex-

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isting refineries and construction of a refinery near Skopje in Macedonia continued.

After 4 years of construction, the annual capacity of the Rijeka refinery in Rijeka, Croatia, operated by INA, was doubled, reaching 8 million tons of crude oil throughput. The production of the additional facilities will be used in the new petrochemical plant on the island of Krk, Croatia, which was under construction at yearend. The petrochemical plant on Krk represents the only foreign investment (by Dow Chemical Co. of the United States) in the mineral-processing sector of Yugoslavia.

Other refineries in the country have plans for further expansion in various stages of implementation. The Sisak refinery in Croatia, operated by INA, has expansion underway that should bring the capacity to 7.5 million tons in 1979. The Bosanski Brod, Pancevo, Novi Sad, and Lendava refineries have plans that call for capacities of 5.5 million, 4.3 million, 2.0 million, and 2.6 million tons per year, respectively, about double the present capacity of these refineries.

Construction continued on a grass roots refinery (2 million tons of crude oil per year) near Skopje, Macedonia, which is designed to process heavy crude from Iran. The U.S.S.R. is providing equipment and technology.

Transportation.—Three major trunk pipeline systems were under construction (one for crude oil and two for natural gas) during 1977.

Construction continued on the pipeline system that will bring crude oil from the Middle East to refineries in Yugoslavia, Hungary, and Czechoslovakia by 1979. The starting point of the 34-million-ton-per-year crude oil pipeline is on the island of Krk near Omisalj, where a deep sea port with berths for two 350,000-deadweight-ton tankers was operational. Cost of the project reached about $510 million, an increase of about 35% over figures published in 1975. A contract valued at $45 million went to Spie-Batignolles S.A., a French engineering and construction company of the Scheider S.A. group, for work to be done on the Omisalj-Sisak section.

Two gas pipeline systems were under construction, one in the western part and the other in the eastern part of Yugoslavia, and are tied with natural gas systems in Austria and Hungary. Both will, in part, use natural gas from the U.S.S.R.

The inauguration ceremony for construction of the natural gas pipeline system in the west took place in March 1977, and completion was scheduled for the end of 1979. The system is about 340 miles long and will supply 26 towns in Slovenia and Croatia with gas from the U.S.S.R. and from local fields. The project includes 50 miles of distribution lines and 344 miles of 16- and 20-inch transmission lines. The network will include 81 metering and regulating stations and will have a total capacity of 2.5 million cubic meters per day. The line crosses the Austrian border near Cersak and proceeds to Rogatec, where it separates into two branches, one to Slovenia and the other to Croatia, near Cakovec, where it will be connected with an existing pipeline system. The Slovenian line to Nova Gorica passes through Celje and Vodice and goes by Ljubljana. It will reach Maribor, Kranj, and Bled Grad. Indications are that the Nova Gorica line may be used for moving gas from Africa and the Middle East as an additional source of supply. The $50 million contract for construction went to Spie-Batignolles as a 50-50 joint venture with Nacap N.V., a Dutch company of Bos Kalis Westminster Group N.V.; engineering was by Gasunie Engineering of the Netherlands.

In eastern Yugoslavia, construction continued on the gas pipeline which passes through Vojvodina and in Serbia branches to Bosnia. The gas was planned to be used for heating in Sarajevo and supplying the Zvornik alumina plant. Financial problems delayed construction. The Mokrin-Senta-Ada-Becej-Gospodjinci trunkline was completed at yearend.

Uranium.—Construction, by Westinghouse Electric Corp., of the first Yugoslav nuclear powerplant (615 megawatts-electric) continued near the town of Krsko in Slovenia. Delays in transportation of heavy equipment from the port of Rijeka to the construction site at Krsko postponed the beginning of operation to May 1979. Work on development of the Zirovski Vrh uranium mine and yellow cake plant by Rudnik Urana Zirovski Vrh of Skofia Loka, Slovenia, also continued, and the beginning of operation was planned for 1979.

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[1]Physical scientist, Branch of Foreign Data.

[2]Gross social product is an economic indicator used by Yugoslav authorities instead of gross national product.

[3]Where necessary, values have been converted from Yugoslav dinars (Din) to U.S. dollars at the rate of Din18.5=US$1.00.

[4]Privredni Pregled (Beograd). Sept. 2, 1977, p. 1.

[5]Politika (Beograd). Apr. 2, 1977, p. 5.

[6]Politika (Beograd). Apr. 15, 1977, p. 7.

[7]Skillings' Mining Review. June 18, 1977, p. 16.

[8]Privredni Pregled (Beograd). Snazan Energetski Potencijal Zemlje (Powerful Source of Energy in the Country). Nov. 28-30, 1977, p. 13.

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The Mineral Industry of Zaire

By Miller W. Ellis[1]

Zaire's mineral industry continued to be the mainstay of the country's economy, and copper accounted for about 60% of the foreign exchange earned by mineral exports. Zaire continued to lead the world in the production of cobalt and industrial diamond and ranked sixth in production of copper. Despite high transport costs and a lack of fuels, copper production increased 8% in 1977, but cobalt and diamond production declined slightly.

Zaire's mineral industry was dominated by the State-owned firm La Générale des Carrières et des Mines (Gécamines), with three major centers in the Zairian copperbelt accounting for the country's output of cadmium, cobalt, zinc, and most of the copper and silver. Shortages of fuel and spare parts curtailed operation of heavy equipment in new pit development and overburden stripping, but production of copper ore, concentrate, and metal increased 8% over that of 1976. As Zaire's chief source of foreign exchange, Gécamines was allowed direct access to 45% of the external credits earned by sales of its mineral products, and the remaining 55% was used by the Government and credited to Gécamines in zaires, the local currency. The zaire was equated with one Special Drawing Right (SDR) of the International Monetary Fund (IMF) in March 1976 and was valued at US$1.25 in 1977.[2]

The allocation of only 45% of Gécamines' total revenue for foreign exchange restricted the company's ability to maintain adequate supplies, spare parts, and fuel from abroad. The Belgian firm Soc. Générale des Minerais (SGM) continued to market most of Gécamines' mineral production, but a new agency, controlled 50% by SGM and 25% each by Gécamines and the Zairian marketing agency Soc. Zairoise de Commercialisation des Minerais (Sozacom), was scheduled to take over this function and that of purchasing and recruiting in Europe by November 1978.

The importance of Zaire's mineral industry to the country's economy increased in 1977 because of improved copper production and diminished returns from its agriculture and manufacturing sectors. Despite Zaire's long-term mineral potential, the effects of the 2-year depression of world copper prices were augmented by domestic financial and administrative difficulties in 1977. Limited availability of foreign exchange restricted orders for equipment and supplies, and increased transport costs and delays in delivery aggravated the problems of maintaining mineral production.

The invasion on March 8 by armed forces along the railway line from Angola had little direct effect on Zaire's copper-cobalt mining industry. However, the resulting evacuation of expatriates employed by contractors working on the Inga-Shaba power transmission line and on construction of new mine plant and housing caused the postponement of Zaire's expansion plans for the mining industry, diminished foreign investment, and prompted a rescheduling of external debt financing.

Gécamines' facilities for producing and processing copper and cobalt have gradually shifted to its western group of mines near Kolwezi as part of an overall program to expand and modernize the industrial complex on a time schedule geared to the completion of the Inga-Shaba powerline terminal at Kolwezi. Despite the financial restrictions imposed by low copper prices since late 1974 and transport problems following the Angolan and Mozambique border closures during 1975 and 1976, Gécamines has managed to meet most of its interim targets and to produce mineral exports accounting for most of the nation's external income.

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PRODUCTION

Mine production of copper and zinc was higher in 1977 but did not attain the 1973-75 levels because of the continued shortages of fuel and supplies. Byproduct silver production increased 10%, tin ore (cassiterite) 34%, tungsten 32%, and coal 28%. Gécamines' production of byproduct cobalt and cadmium declined about 8% to the lowest levels reported since 1967 and 1956, respectively. Other production decreases included diamond 5%, cement 25%, gold 24%, and manganese ore 60%. Details of mineral production are shown in table 1.

Table 1.—Zaire: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Cadmium, smelter	264	r 266	246
Cobalt:			
Mine output, metal content[e]	14,000	11,000	10,200
Refinery	13,638	10,686	10,215
Columbium-tantalum concentrate	80	79	83
Copper:			
Mine output, metal content	r494,800	444,432	481,550
Blister and leach cathodes	462,600	408,230	452,357
Refined	225,900	66,018	98,708
Germanium, content of concentrates kilograms	11,865	NA	NA
Gold[1] troy ounces	103,217	91,083	80,409
Iron and steel: Crude steel[e]	--	30,000	30,000
Manganese ore and concentrate, gross weight	308,525	182,185	41,019
Rare-earth metals: Monazite concentrate, gross weight	298	240	96
Silver thousand troy ounces	2,291	2,472	2,730
Tin:			
Mine output, metal content	4,562	3,776	5,073
Smelter, primary	647	478	765
Tungsten, mine output, metal content	248	e240	317
Zinc:			
Mine output, metal content	r80,400	67,800	73,000
Metal, primary, electrolytic	65,588	61,677	51,049
NONMETALS			
Cement, hydraulic thousand tons	628	re655	489
Diamond:			
Gem thousand carats	395	591	561
Industrial do.	12,415	11,230	10,652
Total do.	12,810	11,821	11,213
Lime	e150,000	e150,000	101,155
Sulfur:			
Byproduct of metallurgy, content of sulfuric acid produced	NA	37,200	30,700
Sulfuric acid, gross weight	NA	NA	151,423
MINERAL FUELS AND RELATED MATERIALS			
Coal, bituminous thousand tons	89	100	128
Petroleum:			
Crude thousand 42-gallon barrels	25	9,075	8,255
Refinery products:			
Gasoline do.	1,056	579	275
Kerosine and jet fuel do.	644	318	142
Distillate fuel oil do.	1,191	698	320
Residual fuel oil do.	1,352	878	351
Other: Liquefied petroleum gas do.	21	12	15
Refinery fuel and losses do.	232	245	110
Total do.	4,496	2,730	1,213

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.
[1]Excludes gold recovered from blister copper.

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TRADE

During 1977, the Soc. de Developpement Industriel et Minière du Zaire (Sodimiza) shipped copper sulfide concentrates by rail through Zambia, Southern Rhodesia, Botswana, and the Republic of South Africa for dispatch from the port of East London to Japan. The same rail route was used for a substantial part of Zaire's other mineral exports, and the returning railcars brought fuel, foodstuffs, and other supplies to the Zairian copperbelt. About one-half of Gécamines' mineral exports were transported by the State-owned Voie Nationale, using a route which included some 1,200 kilometers by rail to Ilebo on the Kasai River, about 1,000 kilometers by barge down the Kasai and Zaire Rivers to Kinshasa, and 366 kilometers by rail down the 650-meter scarp to the port of Matadi on the Zaire River. Some 60 kilometers of the Zaire River outlet to the Atlantic Ocean was subject to constant survey and dredging to maintain a channel for ocean freighters with a draft of less than 28 feet. This transport route has the advantages of being entirely controlled by the Zairian Government, providing employment for Zairian workers, and requiring a minimum of foreign exchange. Transshipment damages and delays in transit were expensive drawbacks. Various plans to alleviate these problems have been under consideration for a number of years. They include construction of a deepwater port at Banana on the Atlantic Ocean, a railroad from Banana to Matadi including a dual-purpose bridge across the Zaire River at Matadi, a rail link from Matadi or Kinshasa to Ilebo to obviate transshipment to and from river barges, and improved Ilebo and Kinshasa river-port facilities and barges equipped for carrying loaded railcars between the two ports.

Use of Shaba's alternate export route by rail to Kalemie on Lake Tanganyika, by lake steamer to Kigoma, and by the Tanzanian railroad to Dar es Salaam was restricted by increased port congestion and charges.

Data on copper exports by type and destination in 1975-77 are given in table 2.

Table 2.—Zaire: Exports of copper, by type and destination

(Metric tons)

Type of copper and destination	1975	1976	1977
Ore and concentrate[1]	29,000	31,400	41,500
Blister:[2]			
Belgium-Luxembourg	231,700	304,404	344,860
France	8,600	10,835	12,010
Italy	--	250	220
Total	240,300	315,489	357,090
Refined:			
Belgium-Luxembourg	45,000	6,997	5,814
France	28,600	7,600	5,649
Germany, Federal Republic of	12,800	--	1,550
Italy	60,000	28,842	42,848
Japan	13,300	17,488	11,893
Netherlands	12,700	637	7,384
Romania	11	4,000	4,000
Other	51,589	8,417	11,505
Total	224,000	73,981	90,643

[1]Details on destinations not available.
[2]Includes leach cathodes.

Source: World Bureau of Metal Statistics. World Metal Statistics. August 1979, p. 70.

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COMMODITY REVIEW

METALS

Copper, Cobalt, Zinc, Associated Metals (Shaba Region).—Although shortages of fuel oil and coke continued during 1977, Gécamines' production of blister copper was reported at about 452,000 tons, 11% over that of 1976. Production of refined copper increased nearly 50% from more than 66,000 tons in 1976 to nearly 99,000 tons in 1977, but it was still far below the 1973-75 levels. Increased production of domestic coal and blending with imported fuels were largely responsible for the increase. Gécamines' cobalt metal production decreased 4.4% from 10,686 tons in 1976 to 10,215 tons in 1977 because of a reported decline in cobalt content of the ore. Byproducts included 246 tons of cadmium, 3,600 troy ounces of gold, and nearly 2,730,000 troy ounces of silver.

Construction of the Dikuluwe-Mashamba (Dima) crushing plant, the concentrator, extensions to the Kamoto concentrator, the Luilu refinery, and additional housing at Kolwezi was interrupted by the invasion in March but was resumed later in the year.

Gécamines' ability to meet many of the interim targets of its expansion program and to continue generating the major part of the nation's income was achieved at the expense of two important aspects of its long-term policy (only minimal funds were available for replacing equipment and stocks of spare parts and for maintaining adequate supplies of consumable stores such as diesel fuel). Transport difficulties delayed or reduced deliveries, particularly of diesel fuel, and as a result, stripping of overburden was far below its scheduled rate. In 1976, the shortfall of overburden stripping in Gécamines' western area (the Kolwezi group of pits) amounted to nearly 11 million cubic meters or about 40% of that scheduled. For 1977, the shortfall amounted to some 12 million cubic meters. During both years, short-term ore production was maintained, but long-term pit planning was complicated by the premature deepening rather than lateral enlargement of the pits, diminishing the number of potential faces for ore extraction. Idle earthmoving equipment from the stripping areas was available to replace disabled equipment in the mining areas.

Most of Gécamines' copper and all of its cobalt ores came from its opencast mines near Kolwezi (western area) and Likasi (central area) and were initially processed at both of these centers. Oxide concentrates were leached and the metals were recovered electrolytically. Sulfide ore from the Kamoto underground mine at Kolwezi was treated at the Kamoto concentrator, and the copper sulfide concentrate was shipped to Lubumbashi for smelting to produce blister copper. Cobalt-rich sulfide concentrate from Kamoto was roasted and leached, and the metals were recovered at the nearby Luilu refinery. All of Zaire's zinc and cadmium came from Gécamines' underground mine at Kipushi, located 35 kilometers west of Lumbumbashi near the Zambian border. Copper sulfide concentrate from Kipushi was smelted at Lubumbashi, but the zinc sulfide concentrate was shipped more than 400 kilometers west to Kolwezi where 51,000 tons of zinc was produced as refined ingots. The Kolwezi facility also produced refined cadmium, silver, and sulfuric acid for consumption in the leaching and electrowinning of copper.

Sodimiza, operated and 80% owned by a consortium of Japanese companies and 20% owned by the State, produced 81,000 tons of copper sulfide concentrate containing 28,000 tons of copper metal at its Musoshi plant for shipment to Japan for smelting. Most of the ore came from its Musoshi mine, but higher grade ore from its new Kinsenda mine was added to the concentrator feed late in the year. Sodimiza's operations, located 40 to 100 kilometers southeast of Lubumbashi near the railroad and the Zambian border, were not directly threatened by the March invasion but continued to operate at a loss because of low copper prices and the high cost of transporting its concentrate through Zambia, Southern Rhodesia, and Botswana to a South African port.

Soc. Minière de Tenke-Fungurume kept its partially completed copper-cobalt mining and metallurgical complex on a care-and-maintenance basis but was considering plans for limited production at yearend. The consortium of British, United States, Japanese, and French companies has reportedly invested $280 million in the project, and it was estimated that an additional $500 million would be required for its completion. The complex was designed to produce about 100,000 tons of copper and 5,000

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tons of cobalt annually from ore deposits located between Gécamines' Likasi and Kolwezi installations.

The French Bureau de Recherches Géologiques et Minière (BRGM) announced in late 1977 that the Zairian Government had granted a subsidiary company, Soc. Minière de Goma (SMDG), permission to develop copper deposits near Kapulo, north of Lake Mweru in the eastern part of the Shaba Region. SMDG was also interested in tin and zinc deposits in the Kivu Region.

Columbium-Tantalum, Gold, Tin, Tungsten.—Production of cassiterite and tin metal from Société Zairetain's mines and smelter near Manono in the Shaba Region increased substantially in 1977. The company was Zaire's only producer of tantaliferous slag and was seeking capital for construction of a plant to produce lithium carbonate from its reserves of spodumene associated with its cassiterite ore. The 20%-State-owned Soc. Zairoise Minière de Kivu (Sominki) reportedly produced 4,060 tons of cassiterite, 317 tons of wolframite, 83 tons of columbite-tantalite, 94 tons of monazite, and 16,525 troy ounces of gold from its various mines in the Kivu Region. The Kilo-Moto mine, in the Haute-Zaire Region, reported an 11% drop in gold production from 66,809 troy ounces in 1976 to 59,479 troy ounces in 1977.

Manganese.—The State-owned manganese mining company Soc. Minière de Kisenge (SMK) reported the production of 41,000 tons of ore from its manganese mines near Kisenge in the western part of the Shaba Region. After the occupation of the area by invaders from Angola in March 1977, mining operations were suspended, and at yearend, a stockpile of some 500,000 tons of manganese ore was reportedly awaiting shipment when the Benguela Railway resumes operations. The company reported no damage to its mining and ore-processing installations, but extensive looting of its offices and housing facilities resulted from the invasion. Less than one-half of SMK's executive staff had returned to work and a large portion of the company's laborers were still missing at yearend.

NONMETALS

Cement.—Zaire's cement production declined 22% from 630,000 tons in 1976 to 489,000 tons in 1977, largely because of a lack of fuel and spare parts at all plants. Approximately 44,000 tons of cement was produced by Cimenteries du Shaba (Cimshaba) from its three rotary kilns in Lubumbashi. Gécamines had arranged to buy 40% of Cimshaba's stock in December 1976 but was unable to supply foreign exchange in payment until yearend 1977. With the funds from Gécamines and a $2.75 million credit from the Zairian State Finance and Development Co., Cimshaba planned to increase its capacity to 162,000 tons per year by 1980. Gécamines' wholly owned subsidiary Calcaire, Chaux, Cimente (C.C.C.), formerly Ciments Métallurgiques de Likasi (CML), produced 403,376 tons of limestone from its quarries at Kakontwe, near Likasi. Its adjacent kilns produced 92,609 tons of burned lime and 13,540 tons of cement for consumption by the parent company. The Cimenterie Nationale (Cinat) plant, which began production in 1974 at Kimpese in the Bas-Zaïre Region, produced 144,659 tons of cement in 1977, less than one-half its rated capacity. Individual production data were not available for the Ciments Lacs SZARL plant near Kalemie on Lake Tanganyika or for the large Soc. des Ciments du Zaire (CIZA) plant near Kinshasa.

Diamond.—Zaire's diamond production dropped 5% to a new low of 11,213,000 carats in 1977, of which only about 5% was classified as gems. The Soc. Minière de Bakwanga (MIBA) was the world's largest producer of industrial diamond from its weathered kimberlite and adjacent alluvial deposits near Mbuji-Mayi in the eastern Kasai Region. MIBA's alluvial deposits were nearing exhaustion, and new technology and equipment were required to treat the harder kimberlite encountered in its deeper pits. MIBA's production was marketed by Zaire British Diamond Distributors Ltd. (Britmond), the local affiliate of De Beers' Central Selling Organization. A diamond-buying market in Tshikapa provided an outlet for small-scale operators working nearby alluvial deposits and old tailings dumps near the Angolan border.

MINERAL FUELS

Coal.—Production of low-grade coal by Soc. des Charbonnages de la Luena reportedly increased during 1977. Most of the output was blended with imported coal and consumed at Gécamines' copper facilities, but part of it was used in the production of cement and lime. The Republic of South Africa, Southern Rhodesia, the Federal Republic of Germany, and Zambia were the chief sources of Gécamines' imported metallurgical coal and coke.

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Petroleum.—Zaire Gulf Oil Co., the manager of Zaire's offshore oilfield, reported that 8,255,000 barrels of crude oil was produced in 1977. Zaire's Moanda refinery near Banana imported 168,336 tons of crude petroleum and produced 32,393 tons of gasoline, 18,352 tons of jet fuel, and 42,980 tons of fuel oil. A substantial quantity of imported gasoline and diesel fuel was consumed by the mining industry in the Shaba Region.

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[1]Physical scientist, Branch of Foreign Data.
[2]International Financial Statistics. V. 31, No. 9, 1978, p. 402.

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The Mineral Industry of Zambia

By Miller W. Ellis[1]

Zambia's mineral industry provided more than 90% of its foreign exchange credit, and maintained the country's position as the world's fifth largest copper producer in 1977. The continued low price of copper, combined with increased costs caused by delays on the Tanzania-Zambia Railway (Tazara) and congestion at the port of Dar es Salaam, resulted in a net loss for the two major copper-producing companies and diminished availability of foreign exchange. Import permits were granted only for essential items, and applications for external funds were approved on a priority basis only when foreign exchange credit was available.

Zambia's 1977 gross domestic product (GDP) was slightly lower in terms of U.S. dollars, at $2,435 million[2] in 1977 compared with $2,686 million in 1976, Although it increased slightly when measured in domestic currency. Export earnings declined from $1,054 million in 1976 to $877 million in 1977, and the value of imports increased from $657 million to $697 million. An increase of $51.5 million in expenditures for machinery and electrical equipment was responsible for the additional import value.

PRODUCTION

Zambia's blister copper production decreased nearly 8% from 706,000 tons in 1976 to 650,500 tons in 1977. Mine production of cobalt increased 13%, and that of lead and zinc decreased 13% and 8%, respectively. Details of mineral production are shown in table 1.

Table 1.—Zambia: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS			
Cadmium metal	6	7	4
Cobalt:			
Mine output, metal content of concentrate	3,164	3,262	3,677
Metal	1,843	2,175	1,704
Copper:			
Mine production:			
Total content of ore	806,273	849,642	819,176
Recoverable content of concentrate	676,921	708,867	658,107
Blister and anodes, Cu content[1]	659,028	705,906	650,512
Refined	629,150	694,943	649,000
Gold[2] troy ounces	[e]8,500	10,955	[e]11,250
Iron ore: Magnetite	223	[e]100	[e]100
Lead:			
Mine output, metal content of ore	26,082	15,549	13,542
Smelter (refined)	19,100	13,583	13,109
Selenium, elemental kilograms	--	--	15,974

See footnotes at end of table.

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Table 1.—Zambia: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
METALS —Continued			
Silver[3] thousand troy ounces	[e]1,000	1,065	[e]1,450
Tin concentrates, gross weight	[e]10	([4])	3
Zinc:			
Mine output, content of ore	67,298	48,777	45,018
Smelter plus electrolytic	46,800	36,327	40,114
NONMETALS			
Cement (hydraulic) thousand tons	[r]452	385	[e]400
Feldspar	1,174	1,027	832
Fluorspar	[re]100	3	[e]10
Gem stores:			
Amethyst kilograms	32,000	25,878	10,252
Emerald do.	NA	18	91
Gypsum	7,536	4,650	4,634
Lime, hydraulic, and quick lime thousand tons	[e]110	144	[e]250
Pyrite, gross weight	19,046	9,118	[e]9,000
Stone:			
Limestone thousand tons	755	565	[e]600
Phyllite do.	22	6	13
Sulfur, elemental basis (produced as sulfuric acid):			
From pyrite	7,295	8,773	8,385
From copper ore	81,057	[re]89,236	[e]86,915
From lead-zinc ore	4,183	1,991	--
Total	92,535	[re]100,000	[e]95,300
Talc	164	106	[e]100
MINERAL FUELS AND RELATED MATERIALS			
Coal, bituminous thousand tons	898	773	708

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.
[1]Includes leach cathodes.
[2]Primarily contained in blister copper and refinery muds.
[3]Refined silver and silver contained in blister copper and refinery muds.
[4]Less than 1/2 unit.

TRADE

Following the departure of Chinese technicians, the Tazara system experienced major operational problems because of inexperienced staff and inadequate maintenance, both along the line and at the port of Dar es Salaam. The Tanzania-Zambia (TanZam) road haulage service was inadequate to relieve the situation, and by yearend the transport time between the Zambian Copperbelt and Dar es Salaam had reportedly increased from 12 days to 22 days. This nearly doubled the tonnage of copper in transit to the port, and, with increased stocks attracting demurrage charges on the docks, the postproduction cost of Zambia's copper was substantially increased. Alternative routes through Malawi and Mozambique to the ports of Nacala and Beira could not be fully used during the rainy season because of bad roads. A maximum weight of 14 tons per vehicle restricted use of the Botswana road route through Francistown and Kazungula.

Changes in the routing of Zambia's exports and imports since 1972 are shown in table 2.

Zambia's favorable balance of trade with the United States diminished substantially in 1977. The value of exports to the United States declined 39% from nearly $150 million in 1976 to $92 million in 1977, while the value of U.S. imports increased 22% from about $60 million to nearly $73 million. Exports to Japan and the Federal Republic of Germany exceeded imports from those countries by factors of nearly 5 and 1.6, respectively, but exports to the United Kingdom continued to be only about 90% of imports. The value of Zambia's 1973-77 trade is shown in the following tabulation, in million dollars:

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	1973	1974[r]	1975	1976	1977[e]
Total exports	1,160	1,419	[r]816	1,054	877
Copper exports	1,092	1,309	735	965	819
Total imports	544	794	[r]936	657	697
Balance of trade	+616	+625	[r]-120	+397	+180

[r]Revised. [e]Estimate.

The balances do not indicate an accumulation of foreign exchange because of repayments, servicing of loans, and other disbursements. The 1976 current account deficit of about $144 million was estimated to have reached nearly $260 million in 1977.

Table 3 shows the amounts and destinations of copper exports, by type.

Table 2.—Zambia: Freight carried, by trade route

(Thousand metric tons)

Route	1972	1973	1974	1975	1976	1977
EXPORTS						
Rail through Southern Rhodesia and Mozambique to Beira	467	[1]5	--	--	--	--
Rail (Benguela) through Zaire and Angola to Lobito	170	438	509	[2]309	[3]131	[3]131
Road through Tanzania to Dar es Salaam	210	284	319	349	323	181
Road and rail through Malawi and Mozambique to Nacala	7	41	10	66	48	34
Road through Tanzania and Kenya to Mombasa	--	45	86	[4]2	12	[5]1
Road and rail through Mozambique to Moatize (road) and Beira (rail)	--	--	--	10	35	--
Rail (Tazara) through Tanzania to Dar es Salaam	--	--	--	46	[6]349	524
Total	854	813	924	782	898	871
IMPORTS						
Rail through Southern Rhodesia and Mozambique to Beira	864	[1]35	--	--	--	--
Rail (Benguela) through Zaire and Angola to Lobito	144	418	438	[2]257	[3]4	[3]1
Road through Tanzania to Dar es Salaam	202	200	289	311	248	156
Road and rail through Malawi and Mozambique to Nacala	39	109	125	129	71	25
Road through Tanzania and Kenya to Mombasa	--	68	86	[4]22	22	[5]3
Road through Botswana to South African ports	--	4	15	41	9	47
Road and rail through Mozambique to Moatize (road) and Beira (rail)	--	--	--	30	58	9
Rail (Tazara) through Tanzania to Dar es Salaam	--	--	--	69	[6]326	413
Air	8	25	29	20	21	18
Total	1,257	859	982	879	[7]759	[7]672

[1]Zambia-Southern Rhodesia border closed January 1973.
[2]Benguela Railway closed August 1975.
[3]Zambia's direct trade with Zaire.
[4]Weight restrictions imposed at Tanzania-Kenya border.
[5]Tanzania-Kenya border closed February 1977.
[6]Tazara Railway began full operation August 1976.
[7]Totals exclude oil imports by the Tazama pipeline averaging 800,000 tons per year in 1976 and 1977.

Table 3.—Zambia: Exports of copper, by type and destination

(Metric tons)

Type of copper and destination	1975	1976	1977
Blister:			
United Kingdom	11,612	1,887	--
United States	--	1,006	--
Yugoslavia	2,492	15,698	5,549

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Table 3.—Zambia: Exports of copper, by type and destination —Continued

(Metric tons)

Type of copper and destination	1975	1976	1977
Blister —Continued			
Other	4,918	2,514	2,579
Total	19,022	21,105	8,128
Refined:			
Belgium-Luxembourg	13,701	17,778	21,122
China, People's Republic of	17,479	20,000	23,493
France	63,558	50,061	66,432
Germany, Federal Republic of	100,550	106,857	90,777
India	7,575	39,538	13,425
Italy	79,320	73,314	72,920
Japan	113,644	124,316	128,231
Sweden	14,712	16,847	19,556
Switzerland	10,525	14,350	9,167
United Kingdom	132,752	96,335	101,621
United States	5	125,773	76,475
Yugoslavia	18,036	183	4,000
Other	44,201	26,994	19,867
Total	616,058	712,346	647,086

Source: World Bureau of Metal Statistics, World Metal Statistics, August 1979, p. 71.

COMMODITY REVIEW

METALS

Copper and Byproduct Cobalt.—The two major Zambian copper companies mined and treated nearly 32.5 million tons of ore containing nearly 837,000 tons of copper and 8,650 tons of cobalt during fiscal 1977. The 15.1 million tons of ore treated by Roan Consolidated Mines Ltd. (RCM) in its fiscal year ending June 30, 1977, contained nearly 319,000 tons of copper and 3,550 tons of cobalt. RCM's production of finished copper was reported at 261,444 tons and sales at 265,446 tons, 7% and 2% lower, respectively, than the fiscal 1976 figures. The average sales price increased 13% to $1,419 per ton; production costs were reportedly $1,022 per ton f.o.b. mine, 7% above the $953 per ton in 1976, but the cost of transport and sales increased substantially.

The Mufulira underground mine was responsible for over one-half of RCM's copper production. Underground development work and improvement of materials handling at the smelter progressed slowly because of the shortage of funds. The electric furnace was shut down for major overhaul in January, and anode production, from the two reverberatory furnaces only, decreased in the early part of the year. Because of increasing world demand for cathode copper, the wirebar casting plant was shut down for most of the year.

Development work was curtailed at Luanshya, where ore dilution and working costs increased and both the quantity and grade of the ore declined. Better ground conditions and higher ore grades with significant cobalt content at Baluba were reflected in greater output during 1977. Equipping of 1,000 meter shafts at both the Chambishi and Chibuluma mines continued, and overburden stripping at the Chambishi and Kalengwa open pits was nearly completed. Cobaltiferous concentrates from Baluba and Chibuluma ores continued to be treated at the Chambishi roast-leach plant, and the cobalt hydroxide product was shipped to NCCM's Rokana cobalt plant where 698 tons of cobalt was recovered as metal. RCM's plant at Ndola for treatment of tankhouse slimes was operational for RCM's refinery slimes during part of the year. The first gold bar was poured in May 1977, but further improvements were needed, especially in the selenium recovery section, for the capacity to treat all of Zambia's copper refinery slimes.

The following tabulation shows ore mined and treated and ore reserves for the various mines operated by RCM for fiscal 1977:

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Mine	Ore mined and treated			Copper produced (metric tons)	Ore reserves	
	Gross weight (thousand metric tons)	Percent copper	Copper content (metric tons)		Gross weight (thousand metric tons)	Percent copper
Mufulira [1]	6,620	2.47	163,514	141,955	139,479	3.08
Luanshya [1]	4,640	1.21	56,202	71,630	68,406	2.46
Baluba [1]	1,430	1.97	28,171		65,662	2.58
Chambishi Pit [2]	850	2.34	19,890	32,486	39,389	2.88
Chambishi [1]	764	2.18	16,655			
Chibuluma [1]	599	3.21	19,225	16,523	7,898	4.68
Kalengwa [2]	149	10.03	14,945	11,422	268	7.36
Total	15,052	2.12	318,602	[3]274,016	321,102	2.86

[1]Underground.
[2]Open pit.
[3]Includes 12,572 tons of toll production for other mines.

Nchanga Consolidated Copper Mines Ltd. (NCCM) treated 17.4 million tons of ore with copper and cobalt contents of 518,000 tons and 5,100 tons, respectively, in it's fiscal year ending March 31, 1977. Finished copper production increased 11% to 427,801, tons and sales increased 10% to 425,931 tons.

Near the end of March 1977, heavy rains caused flooding at the Nchanga open pit and underground mine. As a result, production of ore from the eastern high-grade areas of the lower ore body in the underground mine was restricted until September, and the high-grade zones of mineralization in the open pit remained inaccessible at yearend. Nearly normal ore production from alternative areas of slightly lower grade was maintained in both the open pit and underground mines while dewatering and rehabilitation work continued. A shortage of lime continued to restrict full operation of the Nchanga tailings leach plant throughout the year, but construction of the stage 3 extensions to treat an additional 700,000 tons per month of reclaimed tailings was well advanced at yearend. Deepening of Rokana's Mindola sub vertical shaft, development work on the 3,140 and 3,400 levels, and mining of the central shaft declines to the 3,760 level continued. Production at Rokana continued to be hampered by poor ground conditions and wet ore. The Rokana cobalt plant treated 43,706 tons of cobaltiferous concentrate and produced 999 tons of finished cobalt from Rokana ore as well as 665 tons of cobalt metal for RCM. Ore and concentrate production at Konkola continued at a satisfactory rate, and recovery of copper improved. Water continued to be a major problem at Konkola, where the pumping rate for fiscal 1977 averaged 403,014 cubic meters per day or more than 83 tons of water per ton of ore. Exploration at NCCM's Kansanshi mine continued, and mining commenced in June 1977 at the rate of 15,000 tons per month. The ore, containing about 3.30% copper, was hauled 160 kilometers east to Chingola for treatment. Following metallurgical testing, ore reserves on Kansanshi Hill were recalculated at 10,217,000 tons with 2.99% copper, of which 2.32% was acid soluble. Additional ore reserves underlying the hill contain substantial amounts of sulfide copper but were not recalculated. NCCM's Nampundwe pyrite mine west of Lusaka produced 21,811 tons of pyrite concentrate containing 42.2% sulfur and 1.5% copper. The concentrate was shipped to the Rokana smelter and acid plant for treatment.

Production and ore reserves statistics for NCCM in fiscal 1977 are shown in the following tabulation:

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Mine	Ore mined and treated			Ore reserves	
	Gross weight (thousand metric tons)	Percent copper	Copper content (metric tons)	Gross weight (thousand metric tons)	Percent copper
Nkana[1]	4,712	1.60	75,392	131,363	2.35
Mindola[2]	535	3.00	16,050		
Bwana Mkubwa[2]	648	3.79	24,559	3,509	3.89
Nchanga[1]	2,870	3.41	97,725		
Nchanga[2]	5,347	3.83	204,805	282,019	3.22
Chingola[1]	554	3.32	18,418		
Chingola[2]					
Mimbula[2]	404	2.63	10,628		
Fitula[2]	492	2.94	14,474		
Konkola[1]	1,768	3.14	55,496	123,076	3.55
Nampundwe[3]	69	.61	419	23,058	.77
Kansanshi				35,306	2.22
Total	17,399	2.98	517,966	598,331	2.95

[1]Underground
[2]Open pit.
[3]Underground pyrite mine.

In September, Thomson-Brandt S.A. announced that both NCCM and RCM would share in the wire factory of its new subsidiary, Société de Cuivre S.A., at Chauny, Aisne Department, France, which was scheduled to produce 130,000 tons of copper wire per year.

Lead and Zinc.—The Broken Hill Div. of NCCM produced and treated 253,000 tons of galena-sphalerite ore containing 5.5% lead and 19.1% zinc during its fiscal year. Finished output included 15,034 tons of refined lead, 11,944 tons of high-purity zinc, 21,663 tons of over 98.5% zinc, and 67,034 troy ounces of silver. No byproduct cadmium was reported, and sulfuric acid production ceased when the roaster was shut down in August 1976. In February, the conditioning tower of the No. 1 Waelz kiln overheated and collapsed, damaging both the No. 1 and No. 2 Waelz kilns and the cupellation furnace. Rehabilitation of all units was completed during the year. A 40% force majeure was imposed on lead shipments from Zambia in July and subsequently revoked in September.

Other.—Manganese mines west of Mansa were reopened during the latter part of the year, and a crushing plant at Mansa commenced pulverizing the manganese dioxide ore for battery manufacture by Zambia's Industrial Development Corp. (INDECO). The Finnish company Oy Airam AB was codeveloper and 30% owner of the factory which was scheduled to utilize zinc from Broken Hill and approximately 770 tons of local manganese ore per year to produce about 33 million dry cells annually.

About 3 tons of cassiterite (tin ore) was produced from Mindeco Small Mines Ltd.'s (MSML) cooperative area east of Choma. The Yugoslav-Zambian company Foundry and Engineering Co. Ltd. at Luanshya commenced smelting cassiterite and producing tin ingots as well as bronze castings for local consumption, chiefly in the mineral industry.

NONMETALS

Chilanga Cement Ltd. reportedly produced about 300,000 tons of cement from its three coal-fired rotary kilns south of Lusaka. Most of the product was consumed locally, but some exports to neighboring countries were reported. Ndola Lime Co. Ltd. reported production of 250,000 tons of limestone for smelter flux, 200,000 tons of quicklime, and 7,500 tons of hydrated lime, mostly for consumption by the copper industry. Approximately 4,000 tons of gypsum was produced at the Lochinvar mine by MSML. MSML also produced magnetite near Lusaka for use in the heavy-media coal beneficiation plant at Maamba, about 830 tons of feldspar and fluorite from its mine near Kariba for flux at the Kapiri Mposhi glass factory, and 91 kilograms of emerald from the Kafubu area south of Chibuluma. Illicit mining of emerald reportedly increas-

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ed during 1977. Amethyst mining continued in the Zambezi scarp area 135 kilometers northeast of Livingstone.

MINERAL FUELS

Maamba Collieries Ltd. produced 708,000 tons of coal from its open pit mine and beneficiation plant at the foot of the Zambezi scarp 240 kilometers southwest of Lusaka. A rail spur from Batoka to Musuku on the scarp crest facilitated transport to the Copperbelt.

Indeni Petroleum Refining Co., Ltd., imported 800,000 tons of crude oil through the Tazama pipeline for its refinery at Ndola from which most of the country's gasoline and diesel fuel requirements were supplied. Ammonium nitrate-fuel oil explosives were manufactured at Kafironda on the Kafue River southwest of Mufulira, and heavy fuel oil and residues supplemented coal as fuel for the copper industry.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Zambian kwacha (K) to U.S. dollars at the average exchange rates of K1 = US$1.2675 for 1977 and K1 = US$1.4019 for 1976.

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The Mineral Industry of Other Areas of Africa

By Staff, Branch of Foreign Data

CONTENTS

	Page		Page
Bénin	1101	Lesotho	1115
Burundi	1105	Malawi	1116
Cameroon	1106	Mali	1116
Cape Verde Islands	1107	Mauritius	1119
Central African Empire	1108	Niger	1119
Chad	1109	Réunion	1120
Republic of the Comoros	1109	Rwanda	1120
Congo	1110	São Tomé e Principe	1121
Djibouti	1111	Senegal	1121
Equatorial Guinea	1112	Seychelles Islands	1122
Ethiopia	1112	Somalia	1123
The Gambia	1113	Swaziland	1124
Guinea	1113	Togo	1125
Guinea Bissau	1114	Uganda	1126
Ivory Coast	1115	Upper Volta	1128

BÉNIN[1]

The mineral industry of Bénin contributed less than 1% of the 1977 gross domestic product (GDP), which was estimated at $500 million.[2] Other than limestone and salt, no exploitable mineral deposits have yet been discovered in Bénin, which has been rated by the United Nations as one of the world's least developed nations. In 1977, the economy was further weakened by petroleum price increases and severe drought. The country continued to depend on foreign assistance, which averaged $20 million per year, to finance development projects. The country's first 3-year plan, which was put into operation in October 1977 after many delays, allocated more than $1 billion to projects in infrastructure, agriculture, and light industry.

The most important infrastructure project was the expansion and modernization of the port of Cotonou, valued as an entrepôt port for the transit of goods to the neighboring countries of Niger and Nigeria. Plans called for an increase in handling capacity to 1 million tons of cargo annually, the improvement of port and cargo handling operations, and the upgrading of the efficiency of the Port Autonome de Cotonou (PAC) management system. The $46 million project was to be financed by a consortium led by the International Bank for Reconstruction and Development (IBRD) and including Canada, France, Nigeria, and Abu Dhabi. Construction was scheduled to begin in 1978 and be completed in 1980.

The United Nations Development Pro-

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gram (UNDP) was to complete its assessment of phosphate, iron, gold, and marble deposits by January 1978. The 5-year program conducted by the UNDP focused on geological surveys and mapping, the training of nationals, the establishment of a geochemical laboratory, and the drafting of a mining code for the Government. Phosphate deposits near Kandi were shown to be of potential commercial value if access routes and transport facilities could be provided. Studies continued on the Loumbou Loumbou iron ore deposits, which were estimated to contain 250 million tons of hematite ore averaging 50% iron. Gold deposits south of Natitingou and marble deposits in the Dadjo Region were also the subject of feasibility studies.

The clinker-grinding plant at Cotonou, operated by Société des Ciments du Bénin, produced approximately 140,000 tons of cement in 1977. Cement production was marketed internally by Société Béninoise de Matériaux de Construction. Exports, which went primarily to Niger and Nigeria, were handled by Société Nationale de Comercialisation et d'Exportation du Bénin. Work continued on the construction of a second clinker-grinding plant in Cotonou by the Société Nationale des Ciments. The 200,000-ton-per-year plant was financed by the Arab Bank for Economic Development in Africa and the Bénin Government.

Société des Ciments d'Onigbolo, a joint venture of Bénin and Nigeria, was to construct a third cement plant at an estimated cost of $75 million. The 500,000-ton-per-year plant was to be based on the limestone deposits in Onigbolo and Massé in the southeastern Pobé area. Reserves at the two deposits were reported at 36 million tons.

Salt production remained at low levels in 1977, although capacity was rated at 3,000 tons per year. The modernization of production facilities that manufacture salt from seawater at Cotonou continued throughout the year.

The 3-year plan called for an investment of $200 million in offshore petroleum exploration. In 1977, the Government completed seismic surveys in a concession area previously held by Union Oil Co., whose rights were terminated along with those of five other companies in 1974. Indemnification agreements were reached with most of the affected firms by yearend 1977. Bénin imported approximately 2.5 million barrels of petroleum products in 1977; distribution was by the State agency, Société Nationale de Comercialisation des Produits Pétroliers (SONACOP). The construction of a 17,000-barrel-per-day petroleum refinery in Cotonou was still in the planning stages.

Table 1.—Other Areas of Africa: Production of mineral commodities

Country,[1] commodity, and unit of measure	1975	1976	1977[p]
BÉNIN[2]			
Cement—metric tons	NA	190,000	200,000
Salt, marine[e]—do	150	150	3
Stone: Gravel—do	[e]16,000	[e]16,000	NA
BURUNDI[2 3]			
Clays: Kaolin—do	--	2,362	[e]2,500
Columbium and tantalum ores and concentrates—kilograms	--	4,000	[e]4,000
Gold—troy ounces	368	426	[e]450
Lime—metric tons	798	622	[e]600
Rare-earth metals: Bastnäsite concentrate, gross weight—do	82	139	[e]140
Tin ore and concentrate:			
Gross weight—do	80	26	[e]30
Metal content—do	56	17	[e]20
Tungsten, metal content—do	1	2	[e]2
CAMEROON[2]			
Aluminum metal, primary—do	51,913	57,724	55,593
Cement, hydraulic—do	238,701	298,909	362,953
Gold, mine output, metal content—troy ounces	96	251	182
Petroleum, crude—thousand 42-gallon barrels	--	--	277
Pozzolana—metric tons	NA	17,880	[e]17,880
Stone:			
Limestone—do	46,951	60,463	91,135
Marble—do	1,047	638	678
Tin ore and concentrate:			
Gross weight—do	36	19	21
Metal content—do	19	10	14

See footnotes at end of table.

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Table 1.—Other Areas of Africa: Production of mineral commodities —Continued

Country,[1] commodity, and unit of measure	1975	1976	1977[p]
CAPE VERDE ISLANDS[2]			
Cement, hydraulic[e] metric tons	NA	4,000	4,000
Pumice and related volcanic materials do	NA	15,000	15,000
CENTRAL AFRICAN EMPIRE[2]			
Diamond:			
Gem[e] carats	202,602	171,604	178,145
Industrial[e] do	135,069	114,403	118,764
Total do	337,671	296,007	286,909
Gold[e] troy ounces	529	400	100
CHAD[2]			
Sodium carbonate, natural (natron), slabs (plaques) and broken metric tons	[r]3,572	5,000	[e]11,000
CONGO[2]			
Cement, hydraulic do	[r]55,000	52,000	[e]50,000
Copper, mine output, metal content do	919	408	1,011
Gas, natural:			
Gross[e] million cubic feet	14,000	13,000	7,600
Marketed do	591	533	310
Gold, mine output, metal content[e] troy ounces	[r]7,000	6,900	7,000
Lead, mine output, metal content metric tons	1,997	2,544	2,368
Petroleum, crude thousand 42-gallon barrels	13,460	14,274	12,045
Potash, crude K_2O equivalent metric tons	280,106	256,521	135,500
Zinc, mine output, metal content do	4,475	5,301	5,266
ETHIOPIA[2]			
Cement, hydraulic do	145,000	148,500	[e]73,000
Clays: Kaolin do	50,000	45,000	[e]40,000
Coal: Lignite do	240	[e]200	[e]200
Copper:			
Gross weight do	[e]1,900	1,900	--
Metal content do	400	[e]400	--
Gold, mine output, metal content troy ounces	19,981	11,253	7,725
Gypsum and anhydrite, crude cubic meters	--	--	6,552
Lime metric tons	3,625	--	--
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	585	672	733
Jet fuel and kerosine do	174	198	--
Distillate fuel oil do	1,246	1,451	1,586
Residual fuel oil do	1,408	1,471	1,498
Other do	97	91	152
Refinery fuel and losses do	430	454	601
Total do	3,940	4,337	4,570
Platinum, mine output, metal content troy ounces	162	145	100
Pumice cubic meters	NA	NA	5,000
Salt:			
Rock[e] metric tons	10,000	10,000	5,000
Marine do	75,840	88,000	[e]75,000
Stone, sand and gravel:			
Limestone do	7,315	8,500	[e]8,500
Sand cubic meters	NA	NA	219,471
Other do	NA	NA	959,180
Talc metric tons	25	[e]25	[e]25
GUINEA[2]			
Aluminum:			
Bauxite, gross weight thousand metric tons	8,406	10,848	10,841
Alumina do	643	560	562
Diamond:[e]			
Gem thousand carats	25	25	25
Industrial do	55	55	55
Total do	80	80	80
IVORY COAST[2]			
Diamond:			
Gem[e] do	92	22	[r]7
Industrial do	[e]117	[e]38	11
Total do	209	60	18
Fertilizer materials, manufactured, mixed metric tons	[e]40,000	44,500	[e]48,000

See footnotes at end of table.

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Table 1.—Other Areas of Africa: Production of mineral commodities —Continued

Country,[1] commodity, and unit of measure	1975	1976	1977[p]
IVORY COAST[2] —Continued			
Petroleum refinery products:			
Gasoline ---- thousand 42-gallon barrels	2,163	2,193	2,166
Kerosine and jet fuel ---- do	1,108	1,101	1,388
Distillate fuel oil ---- do	3,370	3,595	3,235
Residual fuel oil ---- do	3,946	4,709	4,482
Liquefied petroleum gas ---- do	110	110	[e]122
Refinery fuel and losses ---- do	369	490	[e]451
Total ---- do	11,066	12,198	[e]11,844
LESOTHO[2]			
Diamond:			
Gem ---- carats	444	891	7,576
Industrial ---- do	2,068	4,125	34,514
Total ---- do	2,512	5,016	42,090
Stone ---- cubic meters	NA	NA	18,572
MALAWI[2]			
Cement, hydraulic ---- thousand metric tons	102	85	94
Gem and ornamental stone: Agate[e] ---- metric tons	4	4	4
Kyanite ---- do	NA	[e]90	250
Lime ---- do	250	250	--
Stone: Limestone ---- do	143,639	149,254	116,653
MALI[2]			
Cement, hydraulic ---- do	49,000	[e]50,000	35,174
Gold, mine output, metal content ---- troy ounces	300	900	[e]932
Salt[e] ---- metric tons	3,000	4,500	4,500
Stone:			
Granite ---- square meters	NA	NA	8,088
Marble ---- do	NA	NA	217
Limestone ---- metric tons	NA	NA	394
MAURITIUS[2]			
Lime ---- do	7,300	7,300	7,500
Salt ---- do	6,000	5,500	6,000
Stone: Basalt, not further described ---- do	NA	400,000	1,574,000
NIGER[2]			
Cement, hydraulic ---- do	17,635	36,240	40,000
Gypsum ---- do	1,017	[e]2,588	[r]3,000
Salt[e] ---- do	1,000	1,000	1,000
Stone, sand and gravel:			
Limestone, not further described ---- do	35,584	56,456	60,000
Gravel[e] ---- cubic meters	49,500	179,268	180,000
Sand[e] ---- do	4,700	5,937	6,000
Tin, mine output, metal content ---- metric tons	98	126	130
Uranium concentrate, U_3O_8 content ---- do	1,540	1,460	1,440
RWANDA[2]			
Beryllium: Beryl concentrate, gross weight ---- do	18	46	[e]55
Columbium and tantalum ores and concentrate:			
Columbite-tantalite, gross weight ---- do	47	45	64
Gas, natural:			
Gross ---- million cubic feet	NA	6	7
Marketed ---- do	NA	6	7
Gold, mine output, metal content ---- troy ounces	425	936	1,814
Lithium minerals: Amblygonite[e] ---- metric tons	30	30	30
Tin, mine output, metal content ---- do	1,422	1,605	1,598
Tungsten, mine output, metal content ---- do	345	432	568
SENEGAL[2]			
Cement, hydraulic ---- do	359,000	386,000	330,000
Clays: Fuller's earth (attapulgite) ---- cubic meters	8,217	4,627	3,405
Fertilizer materials, phosphatic:			
Crude:			
Aluminum phosphate ---- thousand metric tons	201	208	275
Calcium phosphate ---- do	1,682	1,591	1,596
Manufactured:			
Aluminum phosphate, dehydrated ---- do	37	68	69
Other[4] ---- do	8	6	6
Petroleum refinery products:			
Gasoline ---- thousand 42-gallon barrels	912	980	[e]1,038
Jet fuel and kerosine ---- do	897	932	[e]666
Distillate fuel oil ---- do	1,043	1,144	[e]1,551
Residual fuel oil ---- do	1,916	1,855	[e]2,148
Other ---- do	52	43	[e]58
Refinery fuel and losses ---- do	173	153	[e]216
Total ---- do	4,993	5,107	[e]5,677

See footnotes at end of table.

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Table 1.—Other Areas of Africa: Production of mineral commodities —Continued

Country,[1] commodity, and unit of measure	1975	1976	1977[p]
SENEGAL[2] —Continued			
Salt ... metric tons	132,539	141,953	140,000
Stone:			
Basalt ... cubic meters	NA	168,500	[e]168,500
Marble (cipoline) ... do	350	250	[e]250
SEYCHELLES[2]			
Guano ... metric tons	NA	5,670	5,277
Phosphate rock (including coral rock phosphate ... do	[e]3,000	NA	NA
SOMALIA[2]			
Salt, marine[e] ... do	2,000	2,000	2,000
SWAZILAND[2 5]			
Asbestos: Chrysotile ... do	41,219	41,847	38,046
Barite ... do	94	369	--
Clays: Kaolin ... do	2,642	989	--
Coal, bituminous ... do	117,206	154,525	128,990
Fertilizer materials, nitrogenous ... do	NA	NA	3,252
Iron ore, direct-shipping grade, gross weight ... thousand metric tons	1,964	1,744	1,441
Stone: Quarry product ... cubic meters	37,996	50,618	93,490
Tin, mine output, metal content ... metric tons	1	2	2
TOGO[2]			
Clays, for brick production ... do	[e]6,250	4,234	NA
Fertilizer material: Phosphate rock, beneficiated product ... thousand metric tons	[r]1,161	2,008	2,857
Salt ... metric tons	3,000	[e]200	--
Stone:			
Granite ... do	[e]800	606	NA
Marble, dimension ... square meters	NA	1,361	NA
UGANDA[2]			
Beryllium: Beryl concentrate, gross weight[e] ... metric tons	55	54	45
Bismuth, mine output, metal content[e] ... kilograms	4,000	5,000	3,000
Cement, hydraulic ... metric tons	98,400	87,600	80,000
Columbium and tantalum ores and concentrates, gross weight[e] ... kilograms	2,100	2,100	2,100
Copper:			
Mine output, metal content ... metric tons	8,500	7,000	4,000
Metal, blister, primary ... do	8,300	7,000	4,000
Fertilizer materials, phosphatic, crude: Apatite ... do	10,000	15,000	5,000
Iron and steel: Crude steel ... do	15,000	12,000	15,000
Lime, hydrated and quicklime[e] ... do	30,000	20,000	20,000
Salt, evaporated[e] ... do	1,000	500	500
Tin, mine output, metal content[e] ... do	117	120	120
Tungsten, mine output, metal content ... do	58	110	110

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the countries listed, Equatorial Guinea, the Gambia, São Tomé and Principe, and Upper Volta, which are covered in the text of this chapter, presumably produce modest quantities of a variety of crude construction materials (clays, stone, and sand and gravel) and may produce minor amounts of other mineral commodities (most notably gypsum, lime, and salt), but output is not reported quantitatively and available information is inadequate to make reliable estimates of output levels.

[2]In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (clays, stone, and sand and gravel) presumably are produced, but output is not reported quantitatively and available information is inadequate to make reliable estimates of output levels.

[3]Limited quantities of other pegmatite minerals may also be produced, but output is not reported.

[4]Products marketed under the trade names "Balifos" and "Phospal."

[5]Data represent sales; actual production is not reported.

BURUNDI[3]

The mineral industry was a minor factor in the economy of Burundi. The Government's main emphasis in national development has been the diversification of agricultural production and the construction of a firm foundation for industrialization. Mineral production contributed approximately 2.4% of the total national export value of $1.08 million[4] in 1977. Mineral production was limited to small tonnages of bastnäsite and cassiterite concentrates. Deposits of nickel, uranium, cobalt, copper, and platinum were as yet unexploited. The possibility of developing Burundi's lateritic nickel deposits has attracted the attention of a number of foreign countries, including the United States. Nickel reserves were reported in 1977 at approximately 300 million tons of ore of 2% nickel with some copper, cobalt, and platinum content. The deposits

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were located in the eastern and southern part of the country. A U.S. firm was contracted by the United Nations to conduct a detailed mining and metallurgical study of the nickel-bearing laterites.

The UNDP was to finance a program of research and development of the extensive peat deposits at Akanyaru, in addition to the nickel deposits at Musogati.

An analysis of the national transportation network was completed in 1977 by U.S. consultants. By yearend, offers of financial assistance were received from foreign nations for the development of a new transport program. Among the offers received, the European Development Fund (EDF) agreed to provide $27.7 million for the construction of the Myuinga-Kobera-Husomo-Nzega road that will connect with the Kigoma-Dar Es Salaam railroad. The Saudi Arabia Development Fund made available an additional $11 million to the Government for assistance with the transport network.

Construction began on a hydroelectric station at Mugere. Financing of the $1 million facility was to be provided by mainland China. Upon completion in 1979, the station will supply electrical power to Bujumbura, which has relied on the powerplant at Bukaru, 109 kilometers away. The capacity of the Mugere station was expected to reach 6 megawatts during the rainy season and 2 megawatts in the dry season.

CAMEROON[5]

Mining in Cameroon played an insignificant role in the nation's economy in 1977. Small amounts of cassiterite, cement, gold, limestone, marble, and construction materials were produced from domestic sources. Aluminum was produced from imported alumina and cement from imported clinker. Fertilizers were also produced by processing imported materials. Late in the year crude oil production was initiated at a rate of between 8,000 and 9,000 barrels per day from a single offshore platform. Cameroon had known resources of bauxite, copper, kyanite, iron ore, natural gas, and uranium-thorium that were not being exploited in 1977. The Government continued to support prospecting for mineral resources, with primary focus on iron ore in southeastern Cameroon.

The fourth development plan (1976-81) called for significant investment to develop Cameroon's port, railroad, highway, and airport infrastructure. Expansion and modernization of the nation's major port, Douala, began in late 1976 and was to increase the port's handling capacity to 5 million tons per year. Over $300 million was to be invested in realining and refurbishing the Yaounde-Douala section of the Trans-Cameroon railroad, and work began on the Douala-Edea section in 1977. The Government with World Bank and other donor support planned to upgrade and realine the highways between Yaounde and Baffoussam and also between Douala and Yaounde. The Government intended to expand the road system in Nord Province and to construct roads to allow for the development of important resources of iron ore and timber in Center Sud Province. The new Douala air terminal went into service in May 1977, and the Garoua airport was being upgraded to accommodate modern jet aircraft.

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The development of Cameroon's hydroelectric power potential was a major Government priority. Installed electric power production capacity in 1977 was 314 megawatts, 263 megawatts hydroelectric and 51 megawatts thermal. Major projects were the Song Loulou dam on the Sanaga River (288 megawatts) and the Lagdo Dam on the Bénoué River at Njock (72 megawatts). A 225-kilovolt system was planned to link the Lagdo project with Goroua, Figuil, Kaele, and Moroua. Power from the Song Loulou facility was to be used in the planned expansion of the Edea aluminum refinery, the planned petroleum refinery near Victoria, and a new paper pulp factory.

Production of aluminum by Compagnie Camerounaise de l'Aluminium Pechiney-Ugine (ALUCAM) decreased from 57,700 tons in 1976 to 55,600 tons in 1977, or 93% of the Edea smelter capacity. The Edea smelter imported alumina from Guinea and produced a variety of aluminum products including ingot, sheet, plate, and household utensils. Nearly 32,000 tons of aluminum products was exported during 1977 with a value of approximately $35.6 million, or 5.1% of the total value of all exports during the year.

Société d'Etudes des Bauxites du Cameroun (SEBACAM) completed its feasibility study on development of bauxite deposits near Minim and Martap in Nord Province approximately 100 kilometers south of Ngaoundéré. Reserves of over 1 billion tons have been identified, but the lack of sufficient infrastructure for transport or local processing has deterred development.

Preliminary investigations have indicated that substantial resources of iron ore were located in southern Cameroon. The Canadian Government funded the initial mineral survey in this area, and teams provided by the UNDP were conducting more detailed studies during 1977.

Cement production from Cimenteries de Cameroons' (CIMENCAM) two-kiln plant at Fujuil and the Bonaberi clinker-grinding facility totaled 362,900 tons in 1977, a 21.4% increase over the 1976 output of 298,900 tons. A reported 316,800 tons of clinker was imported to supply the Bonaberi grinding plant, which was to be expanded from 300,000 tons per year to 480,000 tons per year by yearend 1978.

Cameroon became Africa's 10th oil producer when production of crude oil from the Kole Marine oilfield began in late November 1977 at an initial rate of 8,000 to 9,000 barrels per day from seven producing wells. The field, located in the offshore Rio del Rey permit (1,126 square kilometers), was owned 51% by Essence et Lubrificants de France-Société de Recherches et d'Exploitation des Pétroles du Cameroun (Elf-Serepea) and 49% by la Société Pecten Cameroon, an affiliate of Shell Oil Co. The 31.4° API gravity crude oil was stored in a 75,000-ton vessel moored near the production platform in 52 feet of water. Output was to increase to over 15,000 barrels per day when an additional nine wells were completed in 1978. Development of two smaller oilfields in the Rio del Rey permit was to bring Cameroon's oil production to 30,000 to 35,000 barrels per day by yearend 1979.

Cameroon planned to construct a 30,000-barrel-per-day oil refinery at Point Limboh near Victoria. Total investment was estimated to be $200 million, although financing and contractual agreements had not been arranged in 1977. During 1977, Cameroon imported approximately 450,000 tons of petroleum products valued at over $91 million, or nearly 12% of the value of all imports during the year.

CAPE VERDE ISLANDS[6]

Mineral production in the Cape Verde archipelago was limited to modest quantities of crude construction materials such as clays, stone, and sand and gravel, and also solar-evaporated salt. The Government has embarked on a program of well drilling to assess the country's underground water resources and of building facilities to impound water from the infrequent but torrential downpours.

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CENTRAL AFRICAN EMPIRE[7]

The mineral industry of the Central African Empire in 1977 was based primarily on the production of diamond, which registered an increase of 4% to nearly 297,000 carats. As a result of international diamond market speculation, the average price of Central African Empire diamond increased 55% to $79[8] per carat in 1977. Diamond exports amounted to $21.6 million, representing 22% of the Central African Empire's total export value. The principal purchasers of diamond in 1977 were Belgium (62%), the United States (15%), and Israel (14%). Problems persisted with undeclared exports of diamond, which reportedly reached 100,000 carats per year.

The Government conducted feasibility studies for the exploitation of the Vakago copper reserves. Also, a systematic analysis of the southern region focusing on the granitic rocks and the construction of a chemical analysis laboratory in Bangui were planned. The joint Central African-Arab-Libyan Mining Co. (SOCALIMINES) was formed during 1977. SOCALIMINES announced expenditures in excess of $42 million over the next 5 years for the prospecting of gold and other minerals. By yearend, no other details were available.

Most diamond found in the Central African Empire was by diggers working numerous small-scale alluvial operations. Large-scale mining of alluvial deposits remained financially unfeasible. No true kimberlite deposits have been discovered in the country. Negotiations were underway at yearend between the Central African Empire, a United States-Canadian joint venture, and an Israeli firm concerning the resumption of mining and dredging operations which ceased in 1976.

Discovered 15 years ago by the French Atomic Energy Commission, the uranium deposit at Bakouma was estimated to contain 17,000 tons of uranium phosphate ore with a metal content of 8,000 tons. In 1975, Société d'Uranium Centrafricaine was formed by the Government, the French Atomic Energy Commission, and Alusuisse of Switzerland for the development of the Bakouma deposit. Feasibility studies indicated that exploitation was economically and technically viable. Preliminary construction at the Bakouma site was scheduled to begin in 1978 with initial production expected in the middle 1980's. Current deposits were estimated to be economically viable for 11 years.

A consortium of petroleum companies consisting of Continental Oil Co. (Conoco), Chevron Oil Co., Shell Oil Co., and Exxon Corp. had petroleum exploration concessions totaling 150,000 square kilometers in the Central African Empire. Exxon acquired a 12.5% interest in the venture from Conoco in 1976. With Conoco as operator, the group relinquished the southern portion of the concession but retained the rights to 74,000 square kilometers of the northern region. Two months of aeromagnetic and seismic surveys were the only activities reported in 1977.

Table 2.—Central African Empire: Trade in mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources and destinations, 1975
EXPORTS			
Diamond: Gem, not set or strung value, thousands	$9,384	$9,236	United States $3,917; Belgium-Luxembourg $2,827; Israel $2,236.
IMPORTS			
Metals:			
Iron and steel semimanufactures:			
Bars, rods, angles, shapes, sections	1,386	778	France 639.
Universals, plates, sheets	684	585	Japan 247; Yugoslavia 129.
Wire	158	--	
Tubes, pipes, fittings	371	536	France 528.
Castings and forgings, rough	--	32	NA.
Nonmetals:			
Cement	12,076	19,333	Zaire 14,967; France 1,445; Portugal 1,383.
Clays and clay products:			
Refractory	473	--	
Nonrefractory	192	--	

See footnotes at end of table.

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Table 2.—Central African Empire: Trade in mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources and destinations, 1975
IMPORTS —Continued			
Nonmetals —Continued			
Fertilizer materials, manufactured:			
Nitrogenous	387	--	
Potassic	3,473	--	
Other	61	728	France 657.
Salt and brines	4,071	4,075	Guinea 3,871.
Fuels and related materials:			
Asphalt and bitumen, natural	--	14	All to Yugoslavia.
Petroleum refinery products:[1]			
Lubricating oils and greases	424	477	NA.
Nonchemical coal and petroleum wastes	1,462	--	
Other	179	614	France 123.

NA Not available.

[1]Because of the limited amount, petroleum products are not converted to 42-gallon barrels.

CHAD[9]

The mineral industry of Chad, a landlocked nation covering nearly 500,000 square miles in the heart of north-central Africa, played an insignificant role in the country's economy in 1977. Mineral output was confined to small amounts of trona, clays, salt, and local requirements of building materials. Trona, locally called natron, was the only mineral product that was exported, with small amounts going to neighboring Nigeria and Sudan.

Mineral surveys conducted by French interests and by the UNDP have discovered evidence of gold, nickel, uranium, complex sulfide ores, and small amounts of diatomite, kaolin, and limestone. Continental Oil Co. of Chad (Conoco-Tchad) continued to explore for oil on a 174,000-square-kilometer concession in southern and west-central Chad. Conoco-Tchad was owned by Shell (50%), Chevron (25%), Esso (12.5%), and the operator Continental (12.5%). Conoco-Tchad completed the Kadeni No. 1 well in southern Chad in June and was drilling the Mangara No. 1, also in southern Chad, at yearend.

The Government and the Cononco-Tchad consortium formed Société d'Étude et d'Exploitation de la Raffinerie du T'chad (SEERAT), which was to build a refinery at N'Djamena and a 350-kilometer-long, 15-centimeter-diameter pipeline from the small Sedigi oilfield near Lake Chad to the refinery. Construction of the 1,500-barrel-per-day unit was to begin in 1978 and be completed by late 1979.

REPUBLIC OF THE COMOROS[10]

No exploitable minerals have yet been discovered in the Republic of the Comoros, an archipelago of islands situated in the Mozambique Channel off the southeast coast of Africa. The economy, which is largely agricultural, suffered from severe drought in 1977. The country's austerity budget was supplemented by foreign loans and grants from Arab states. All financial aid from France was terminated in 1975 when the Comoros made a unilateral declaration of independence. Almost all industries were nationalized by the new Government, including the largest oil distributor, Royal Dutch/Shell. Petroleum products were supplied largely by Madagascar. The country's primary trading partners were Madgascar, Tanzania, Kuwait, and Saudi Arabia.

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CONGO[11]

The loss of the potash industry and a decline in the production of other mineral commodities reduced the contribution of the Congo's mining sector to the 1977 GDP of $720 million.[12] Petroleum continued to be the major mineral revenue earner and accounted for 75% of export revenue. The Congo also produced copper, lead, and zinc concentrates and small amounts of gold, cement, and natural gas. Owing to the deterioration in the country's financial situation, the 3-year development plan (1975-77) was abandoned. The balance-of-trade deficit increased to $53 million in 1977. At yearend, the Government introduced an interim 2-year (1979-80) budget of $93 million while a comprehensive 5-year plan (1980-84) was being developed.

Production of potash at the Holle mine was curtailed in June 1977 owing to severe flooding after the rupture of the overlying dolomite aquifer. Production in 1977 was approximately 136,000 tons of K_2O compared with 256,521 tons of K_2O in 1976. The Holle mine, located 45 kilometers northeast of Pointe Noire, was operated by Compagnie des Potasses du Congo (CPC). Reserves were estimated at several billion tons of potash. However, technical difficulties at Holle had kept output well below anticipated levels.

At the time of the flooding of the Holle mine, investigations were being carried out regarding the exploitation of carnallite deposits in the vicinity. It had been determined that exploitation of the sylvinite deposits was becoming increasingly unprofitable owing to adverse geological factors. At yearend 1977, CPC was liquidated and there were no immediate plans to rehabilitate the potash operation. Interests in CPC were held by the Government (15%), Entreprise Minière et Chimique (36.125%), Bureau de Recherches Géologiques et Minières (BRGM) (36.125%), and Essence et Lubrificants de France-Entreprise de Recherches et d'Activités Pétrolières (Elf-Erap) (12.75%). Prior to the liquidation of the company, the French partners had been negotiating a withdrawal of shares in the potash mine.

Petroleum production in the Congo declined from 2 million tons in 1976 to 1.8 million tons in 1977. Oil was produced by Elf-Congo, a subsidiary of Elf-Erap, and Azienda Generale Italiani Petroli S.p.A. (Agip), a subsidiary of Italy's Ente Nazionale Idrocarburi (ENI). Approximately 98% of production was from the Emeraude field, owned 65% by Agip and 35% by Elf-Congo. Although it was originally expected to reach a production level of 100,000 barrels per day, the Emeraude field averaged 34,000 barrrels per day in 1977. The smaller Pointe Indienne field averaged 200 barrels per day.

The new Loango field, owned 65% by Agip and 35% by Elf-Congo, began production in September 1977. During the year, Agip sought to raise a $25 million, 6-year loan to finance development of the Loango field. Two producing wells were drilled, and plans called for an additional 40 wells to be completed. Output was expected to average 40,000 barrels per day upon completion. A 97-kilometer, 18-inch pipeline was to link the field with the Djeno terminal, which also handled Emeraude crude.

The Government actively encouraged oil companies to engage in offshore petroleum exploration. The SEAGAP consortium prepared to drill a wildcat well offshore in waters more than 4,000 feet deep. Members of the group, which held an 8,000-square-kilometer permit area, were Getty Oil Co., Agip, Phillips Petroleum Co., and Hispanoil. The state-owned Hydrocongo held a 32% interest in the venture and an option to increase its share to 49% if there was a commercial discovery.

The Congo's first petroleum refinery, under construction at Pointe Noire, was to begin production in 1978. Commissioning of the refinery was delayed owing to technical problems, and the Government was seeking additional financing to make the plant operable. Construction of the 1-million-ton-per-year refinery was by the Belgian consortium Sybetra. The refinery was to be owned and operated by Hydrocongo and supplied by Emeraude crude.

Marketed natural gas production was approximately 310 million cubic feet in 1977. Reserves of natural gas at the Pointe Indienne field were estimated at 12 billion cubic feet. Output was sold to CPC for use in the Holle potash plant.

Production of copper, lead, and zinc concentrates by Société Minière de M'Passa continued to decline owing to the depletion of higher grade reserves. In 1977, copper concentrate production was approximately 13,000 tons. Base metal production was to be greatly augmented by the mining of copper, lead, and zinc ores by Société Na-

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tionale des Mines de M'Fouati (SONAMIF) in the Boko Songo area. Reserves were estimated at 300,000 tons averaging 28% lead, 9% zinc, and 4% copper. Annual production of 30,000 tons of lead concentrate and 4,000 tons of copper concentrate was to begin in 1978.

Société Nationale des Mines de Sounda-Kakamoeka (SONAMIS), a joint venture of the Congo and the Soviet Union, continued development of gold deposits in the Kouilou area north of Pointe Noire. The alluvial gold deposits were estimated to contain reserves of 4,500 kilograms.

Production of cement at Cimenterie Domaniale de Loutété (CIDOULOU) plant was reported at 50,000 tons in 1977. CIDOULOU planned to complete expansion of the plant from 60,000 tons per year to 100,000 tons per year by 1978. A second cement plant was to be built at Fatima, near Bangui, with an annual capacity of 120,000 tons per year.

Table 3.—Congo: Foreign trade in mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations and sources, 1976
EXPORTS			
Copper ore and concentrate	3,274	704	West Germany 670.
Diamond: Gem, not set or strung value, thousands	$1,649	$1,270	Netherlands $726; Belgium-Luxembourg $496.
Fertilizer materials: Potassic	408,159	400,379	France 90,059; South Africa 86,150; Brazil 43,890.
Lead ore and concentrate	11,501	11,404	All to France.
Petroleum:			
Crude thousand 42-gallon barrels	13,617	13,303	United States 6,692; Italy 3,256; Spain 1,937.
Refinery products:			
Kerosine 42-gallon barrels	58,668	73,346	NA.
Zinc ore and concentrate	--	3	All to France.
IMPORTS			
Aluminum, unwrought and semimanufactures	58	70	France 48.
Cement	28,110	23,905	Zaire 22,904.
Clays and clay products: Nonrefractory	933	1,119	France 549; Italy 252; West Germany 244.
Crude nonmetallic minerals, n.e.s.	1,331	607	NA.
Gas, hydrocarbon	21,912	20,567	Gabon 14,059; France 5,800.
Iron and steel semimanufactures:			
Iron and steel shapes	6,165	4,280	France 3,818.
Universals, plates, sheets	3,042	3,395	France 1,512; Japan 1,423; People's Republic of China 267.
Railway rails, etc.	2,003	5,688	All from France.
Iron and steel wire	484	177	France 156.
Iron and steel tubes, pipes, etc	1,977	806	France 528; West Germany 91.
Nonferrous metals, n.e.s. value, thousands	$132	$140	NA.
Petroleum refinery products:			
Gasoline 42-gallon barrels	250,861	272,731	Gabon 234,668; Algeria 14,561.
Kerosine do.	187,907	308,249	Gabon 227,959; Netherlands Antilles 56,800.
Distillate fuel oil do.	201,636	104,060	Gabon 90,102.
Residual fuel oil do.	--	22,458	All from Gabon.
Lubricants do.	15,302	12,712	Netherlands 6,244; Ivory Coast 3,192; France 2,485.
Nonchemical coal and petroleum wastes	--	539	NA.

NA Not available.

DJIBOUTI[13]

No mineral exploitation has yet been initiated in Djibouti, which received its independence from France on June 27, 1977. The economic income of Djibouti, formerly the French Territory of Afars and Issas, was based on entrepôt trade through the port of Djibouti and along the Chemin de Fer Franco-Ethiopian (CFE) railroad. Customs duties were the major contributor to the 1977 gross national product (GNP) of approximately $180 million.[14] The country continued to have a severe balance-of-trade deficit, estimated at $48 million in 1977, and suffered from an unemployment rate of about 90%. Subsidies from France and Saudi Arabia sustained the economy in 1977, and Djibouti sought further aid from other Arab states.

The CFE railroad, which links Djibouti and Addis Ababa, Ethiopia, was closed

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in June 1977 owing to civil conflict in Ethiopia. Trade along the 780-kilometer railroad consisted primarily of Ethiopian imports and exports. Traffic at the port of Djibouti similarly decreased. In 1977, a British firm was employed to conduct a feasibility study for expansion and modernization of the port. A new 247-kilometer road establishing a connecting link between Djibouti and Addis Ababa was opened in June 1977.

Potential mineral projects in Djibouti included extraction of gypsum and salt from Lake Asal and the construction of a cement plant at Mount Arrey based on local limestone deposits. Recent legislation was aimed at encouraging foreign investment in mineral and petroleum exploration and exploitation through providing various tax exemptions and economic incentives. Evaluation of geothermal resources in the area of Lake Asal was conducted with technical and financial assistance from BRGM of France.

EQUATORIAL GUINEA[15]

Information about the economy and industry of Equatorial Guinea has not been available since March 1976. There were no reported changes in the oil concessions around Isla de Macias Nguema Biyogo (formerly Fernando Po) or off the coast of the mainland Province of Rio Muni, nor were there any indications that exploration for oil had been resumed. Mineral products for use as local building materials presumably included clay, sand, and stone, but investigations of previously recorded indications of phosphate, iron ore, and radioactive materials were not reported during 1977.

ETHIOPIA[16]

The mineral sector of Ethiopia contributed less than 1% to the estimated 1977 GNP of $2.9 billion.[17] The manufacture of cement and the refining of imported crude oil were the major mineral activities. Ethiopia also produced small amounts of gold, platinum, and salt. The economy continued to suffer from an external debt estimated at $400 million and a balance-of-trade deficit of $160 million in 1977. Foreign trade in minerals was disrupted by the irregularity of transport on the Addis Ababa-Djibouti railroad caused by civil conflict.

Although the country's mineral potential was believed to be excellent, it remained relatively undeveloped. Exploration and production of most minerals were nationalized by the Ethiopian Provisional Military Government (EPMG) in 1975. Mineral prospecting was minimal in 1977. The United Nations was to begin a $2 million study of geothermal resources for power development in 1978. During the year, Ethiopia participated in establishing the East Africa Minerals Development Center, intended to advise member states on planning and implementing geophysical and geological surveying programs.

Ethiopia's sole petroleum refinery at Assab in Eritrea Province produced 4.6 million barrels of petroleum products in 1977. The refinery, which had a capacity of 14,000 barrels per day of petroleum products, was owned and operated by the Ethiopian Petroleum Share Co. All crude oil was imported from Saudi Arabia. Petroleum products were marketed domestically by Mobil Oil East Africa Ltd., Shell Oil, Agip, and Total Oil; the Government held a 51% interest in each of the petroleum distributing companies. Owing to political uncertainty in Ethiopia, all petroleum exploration activity ceased in 1976.

Cement production was approximately 150,000 tons in 1977. The output of Ethiopia's two cement plants was based on local limestone and gypsum deposits. The Eritrea Cement Co. plant at Massawa had a rated capacity of 70,000 tons per year. The Addis Ababa cement plant, operated by the Ethiopian Cement Corp., had an 80,000-ton-per-year capacity.

Salt output from solar pans along the Red Sea was about 80,000 tons. The two major saltworks in Eritrea each had a rated capacity of 100,000 tons per year. Production by Societa Saline di Massawa and Société des Salines d'Assab was mostly for export.

In 1977, the Ethiopian Ministry of Mines, Energy, and Water Resources signed a tech-

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nical agreement with the Soviet Union to modernize the Adola gold operation to expand production. Gold from the Adola alluvial deposits, situated in Sidamo Province in southern Ethiopia, was recovered by traditional panning. Output ranged between 7,000 ounces and 20,000 ounces per year. A small amount of platinum was produced at the Government mine at Yubdo in Wollega Province.

THE GAMBIA[18]

The Gambia, a small west African republic extending some 320 kilometers inland from the Atlantic coast and only 11 to 32 kilometers wide along the lower reaches of the Gambia River, had negligible mineral production in 1977. Heavy beach sand deposits in the Western Division and kaolin in the Upper River Division were the only known significant mineral deposits. Production of unreported amounts of clay, sand, stone, and gravel undoubtedly took place to supply local building requirements. Offshore petroleum exploration rights were held by Aracca Petroleum and by Chevron Overseas Petroleum Co.

The Gambian economy expanded markedly with the GDP reaching $116 million[19] in 1977, an increase of 22% compared with 1976. Exports increased 46% to nearly $50 million, while imports increased 8% to $80 million. The Gambia continued to import almost all of its requirements for cement, fertilizers, iron and steel products, and refined petroleum products.

GUINEA[20]

The mineral industry of Guinea continued to be an important contributor to the nation's GDP, which was $1.1 billion[21] in 1977. Bauxite and alumina were the principal mineral products, and exports of these products provided nearly 97% of the country's foreign exchange earnings.

Guinea is well endowed with natural resources. The country contains about one-third of the world's high-quality tropical bauxite, several billion tons of iron ore, a significant diamond reserve, alluvial gold, indications of offshore petroleum, and uranium prospects along the northern tier near the Mali border. Guinea is the source of the Niger, Senegal, and Gambia Rivers, giving the country an estimated hydroelectric potential of 7,200 megawatts. Only 24% of the nation's 7 million hectares of arable land was under cultivation in 1977.

Guinea produced an estimated 11 million tons of bauxite in 1977 and was the world's third largest bauxite producing country. Compagnie des Bauxites de Guinée (CBG), operator of the Sangaredi mine in the Boke concession area, had an output of over 7 million tons; Office des Bauxites de Kindia (OBK) produced more than 2 million tons from the Delebe deposits; and Société d'Economie Mixte Friguia, which mined bauxite for alumina production in Guinea, had an output of slightly less than 2 million tons.

CBG, owned by Halco Mining Inc. (51%) and the Government (49%), continued to expand output and planned to produce 9 million tons of bauxite per year beginning in 1979. CBG shipped high-grade bauxite from its plant and port at Kamsar primarily to members of Halco, a consortium of aluminum producers consisting of Aluminum Co. of America (Alcoa) (27%), Alcan Aluminum Ltd. (27%), Martin Marietta Aluminum Inc. (20%), Pechiney-Ugine-Kuhlmann (PUK) (10%), Vereinigte Aluminium-Werke (VAW) (10%), and Montedison S.p.A. (6%).

OBK, Government owned, exported ore primarily to the Soviet Union from loading facilities at Conakry. OBK initiated production in 1974 from the Delebe mine which was built with technical assistance and financing provided by the U.S.S.R. Reportedly 90% of the mine's output was contracted to the Soviet Union and the remaining 10% could be sold either on the world market or to the U.S.S.R.

Friguia, owned by Frialco Co. (51%) and the Guinean Government (49%), produced approximately 560,000 tons of alumina in its plant near Kimbo approximately 145 kilometers northeast of Conakry. Alumina was shipped from Conakry to the members of Frialco, another consortium consisting of Noranda Mines Ltd. (38.5%), PUK (36.5%), British Aluminium Ltd. (10%), Alusuisse (10%), and VAW (5%). Friguia was plan-

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ning to expand the capacity of the Kimbo mine and alumina refinery to 4 million tons per year of bauxite and 1.2 million tons per year of alumina by 1983.

Société Guinea-Arabe d'Alumine et d'Aluminium (Alugui) planned to develop the Ayekoye concession in the Boke Region approximately 20 kilometers northwest of the Sangaredi mine. Alusuisse was to conduct detailed exploration, complete feasibility studies, and produce preliminary designs for the project, which was to produce 9 million tons per year of bauxite, 2 million tons per year of alumina, and eventually 150,000 tons per year of primary aluminum. The aluminum smelter was to be supplied with power from proposed hydroelectric powerplants that were to be constructed on the Konkoure River with a capacity of 600 megawatts. Reserves at the Ayekoye concession were estimated at 500 million tons of ore with an alumina content of 51.6% to 59.6%. Alusuisse was to report its findings in mid-1978 to Alugui which was comprised of the Governments of Egypt, Guinea, Kuwait, Libya, Saudi Arabia, and the United Arab Emirates.

Two other large bauxite deposits in Guinea have been studied in detail. The Government and Alusuisse venture, Société Minière et du Participations Guinée-Alusuisse (SOMIGA), planned to develop the Tougué deposits, estimated to contain over 2 billion tons of ore with an average alumina content of 44%. An eventual production level of 8 million tons per year of bauxite and 1.2 million tons per year of alumina was slated for completion by the mid-1980's. Société des Bauxites de Dabola, a joint venture composed of Guinea, Algeria, Nigeria, and Yugoslavia, planned to develop the 450-million-ton Dabola deposits and produce 1 million tons per year of alumina. Bauxite production level was to be determined later by the needs of the participants.

In 1973, Mifergui-Nimba, a consortium of foreign, private, and governmental interests (50%) with the Guinean Government (50%), was set up to develop the high-grade iron ore deposits at Mount Nimba near the Liberian border in southeast Guinea. During 1977, Kaiser Engineers was conducting a feasibility study, which was to be completed in mid-1978. The Mount Nimba ore body consists of two high-grade deposits, at Pierré-Richard and Sempété, each with over 300 million tons of friable hematitic ore containing 65% iron and generally less than 2% magnetite. Development of the Nimba deposits was to be accomplished by 1985, to produce 15 million tons of iron ore per year for 40 years.

In October, Compagnie Générale des Matières Nucleaires (COGEMA) of France began a program of uranium exploration in the Labe Region of northern Guinea. Reportedly, firms from Japan and Italy expressed interest in joining the French uranium exploration effort.

Guinea planned to construct a 200,000-ton-per-year cement clinker grinding plant near Conakry to supply most of the nation's cement demand. The Government was also considering building a 200,000-ton-per-year cement plant either at Kindia 100 kilometers northeast of Conakry or at Siguiri on the Niger River near the Mali border.

International Diamond Corp. Ltd. of the United Kingdom was to begin alluvial diamond mining near Kissidougou in 1978. Diamond resources in southeast Guinea have been estimated to exceed 300 million carats with two-thirds being of gem quality.

In 1977, Société de Guinée des Pétroles (SOGUIP) drilled a single exploration well in its 44,000-square-kilometer offshore concession. The BA-1, a dry hole, was abandoned at 3,350 meters.

GUINEA BISSAU[22]

Guinea Bissau, a small west African nation of 800,000 inhabitants and a GDP of $112 million,[23] had no reported mineral production in 1977. Small amounts of clays, sand, stone, gravel, and marine salt were produced for local consumption. Resources of bauxite, gold, iron ore, phosphate rock, titanium sands, and zircon have been reported but remained undeveloped in 1977. The country neither produced nor refined crude petroleum and was dependent on imports for its liquid hydrocarbon requirements. No petroleum exploration activity took place during 1977, although Agip applied for an offshore exploration license.

The Government established the National Company for Oil and Mining Research and Exploration (PETROMINAS) in March. The company was created with the objective of promoting the exploration and research

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of mineral and petroleum resources throughout the country and abroad. The company received administrative and fiscal autonomy but remained under the tutelage of the State Commission of Energy, Industry, and Natural Resources.

During 1977, teams from the Soviet Union began more intensive studies of the bauxite deposits in the Boe Region of west-central Guinea Bissau. During 1975, Soviet investigators had completed 48 test borings in the area and estimated that approximately 500 million tons of commercial-quality bauxite was located in Guinea Bissau.

IVORY COAST[24]

No mineral production was reported in the Ivory Coast during the year. A large deposit of low-grade iron ore has been found near Main, but plans to exploit it were postponed indefinitely owing to low demand and consequent low prices in the international markets. However, oil exploration paid off during the year. After more exploratory work on their permit H-1, Exxon-Shell decided to bring the deposit, found in 1974, into production. The oil reservoir, located 15 kilometers off the coast near Grand Bassum, reportedly contained 70 million barrels, a volume that could be increased if water injection proves feasible. Production was expected to begin in 1980 and to reach a peak of 8,000 barrels per day by 1982 or 1983. After about a year of peak production, output is expected to decrease. A drilling production platform designed for 10,000 barrels per day of oil and 5 million cubic feet per day of gas was ordered from Fluor Corp. Oil was to flow by submarine and overland pipeline to the Abidjan refinery.

Per capita GDP increased to approximately $700[25] in 1977 from $623 in 1976, although the country had minimal mineral production during this period.

In June 1977, significant diamond production ceased when Société Waston stopped all operations at the diamond deposit in the Séquéla Region, which had produced since 1971. Total production from the Babi diamond deposit, which was also terminated, was 17,800 carats, involving the treatment of 128,000 cubic meters of gravel. Diamond exports totaled 27,000 carats.

Société pour le Developpement Minière de la Cote d'Ivoire (Sodemi), the Ivorian State prospecting company, examined lateritic nickel mineralization in the Biankoumu zone and copper-nickel sulfides and radioactive minerals in the northern regions of the country. Discussion between the Sodemi representatives and the Canadian company Falconbridge Nickel Mines Ltd., concerning the possible development of the known lateritic deposits, continued during the year. Also Sodemi's cooperation continued with the BRGM on prospecting for iron ore and manganese and on beach sand studies. No results of significance were reported by the end of 1977.

The iron ore deposit found in the Mount Klahoyo Region of the country, about 600 kilometers northwest of Abidjan, remained dormant. A meeting was held during the year to further assess the exploration effort, the shape of the ore body, reserves, and exploitation techniques. However, it was decided that new partners should be invited to participate in feasibility studies and the large investment needed for beneficiation of this deposit.

Gold deposits at Ity, 60 kilometers west of Main, were not brought to the beneficiation stage. The consortium established for this purpose continued complementary exploration to prove more ore reserves and to perform more research work on the beneficiation of the ore.

LESOTHO[26]

The 1977 mineral industry of Lesotho consisted almost exclusively of diamond production. A small amount of crushed stone was produced for domestic consumption. Diamond output of 42,090 carats was valued at $6.4 million,[27] compared with 5,016 carats at $0.4 million in 1976.

Lesotho's petroleum needs were satisfied by imports from the Republic of South Africa. Petroleum exploration in Lesotho was conducted on a limited basis in 1977. Exploration and feasibility studies were undertaken to ascertain the commercial viability of Lesotho's coal deposits.

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The Letseng-la-Terai diamond mine reached its planned production level in September 1977 by treating 680,000 tons of ore and recovering 22,688 carats of diamond. Two kimberlite pipes were identified as diamondiferous. Both pipes penetrate 1.5 kilometers vertically into Karroo Stormberg basaltic lavas. The hard blue kimberlite of the main pipe was overlain by 1 meter of altered basalt followed by basaltic gravel. The circular open pit mine has a standard bench height of 5 meters with plans for an ultimate practical depth of the main pipe of 135 meters with an average backslope of 40°. The waste-to-ore ratio was calculated at 1.2:1.0. The mine has a minimum life of 8 years.

The water supply was obtained through a pipeline from the Khakelu River, while electricity was provided by a 88,000-volt line from the Lesotho Electricity Corp. power network. The Letseng mine employed 760 people, including 682 Lesotho nationals. De Beers Lesotho Mining Co. (Pty.) Ltd. has begun an extensive training program for Lesotho nationals.

The Letseng mine was jointly owned by the Government (25%) and De Beers Consolidated Mines Ltd. (75%). Diamond sales through the Central Selling Organization in London was to be conducted by the Diamond Corp. Lesotho (Pty.), a Lesotho firm. Under the agreement with De Beers, when capital costs have been recovered, 62.5% of the profits are to be realized by the Government, rising later to a maximum of 72%.

MALAWI[28]

The mineral industry of Malawi contributed very little to the nation's GNP of $821.6 million[29] in 1977. The major mineral product of Malawi continued to be marble from the Changlume quarry near Zomba which was used in cement manufacture. Small quantities of unreported dolomite, clays, sand, stone, and gravel were produced for domestic consumption, and Gemstones Ltd. continued to export agate, aquamarine, and smoky quartz.

The Malawi Mineral Development Section of the Chamber of Mines of South Africa completed field investigations on alluvial apatite deposits in the southern region and carried out geochemical sampling programs for copper and nickel on ultrabasic intrusives in the southern and central regions.

British Gypsum Ltd. (BGL) was granted a mining lease covering the Kapirikamodzi vermiculite deposit and exported a trial shipment of 90 tons to the United Kingdom. BGL continued to hold exclusive prospecting rights covering the Kapiridimba kyanite mineralization area.

Agip was granted an exclusive license to explore for radioactive materials in three blocks of country underlain by Karroo deposits. Agip carried out airborne and follow-up geophysical surveys and exported samples for detailed analysis.

Gemstones Ltd. concentrated investigations on an emerald prospect in the Mzimba District. The Geological Survey Department carried out a reconnaissance survey of eight pegmatites in the Mzimba District which contained promising concentrations of emerald, aquamarine in association with green and black tourmaline, and rose and amethystine quartz.

During 1977, Malawi had no significant mineral exports and relied heavily on imports to supply its needs for metals, fertilizers, and fuels. The country had its first positive materials trade balance in 1977 because of the increased value of agricultural exports such as tea, tobacco, coffee, and cocoa.

MALI[30]

Mineral production in Mali for calendar year 1977 was valued at approximately $5.6 million[31] and thus formed a minor sector of the nation's GNP of $645 million at current prices. Reported mineral production included gold ($128,000), salt ($115,000), limestone ($96,000), marble ($12,000), granite ($140,000), and cement ($5.1 million).[32] In 1977, manufacturing, including gold and silver handicrafts, accounted for 14% of the GNP, an increase of 3% over the 1976 contribution. The Malian economy in general continued to show modest improvement and had a real GNP growth of 7% (based on

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1969 constant prices).[33]

While virtually all large enterprises were owned by the Malian State, with the few remaining having mixed ownership, the investment climate for foreign firms was considered favorable. The need to attract foreign capital prompted the military government to liberalize the investment code with foreign concerns exempted from taxes for 5 years. The Government was also stressing geological, mining, and petroleum exploration. Mali was expected to abide by its investment code which requires a minimum Government ownership of 10% to 50%. A lack of adequate infrastructure was still a constricting factor for development.

Total exports were valued at $125.5 million, while total imports were valued at $170.2 million, resulting in a net trade deficit. However, the trade deficit decreased by 17% compared with the 1976 deficit and by 53% compared with the 1975 deficit. France was Mali's leading supplier, including industrial and transportation equipment, cast iron, iron and steel items, and chemical products. Over half of all supplies are imported through Dakar, and approximately 48% comes through Abidjan. Most fuel was imported by rail. Fertilizers and cement make up most of the tonnage hauled by road. The Malian Railway Administration purchased new tank cars for increased fuel transportation by rail. Of total imports for 1977, 31% was equipment, 16% was chemicals and pharmaceuticals, 14% was building materials, and 10% was food. Fuel imports were up 13% compared with 1976. Agricultural products formed most of Mali's exports.

The country was almost entirely dependent on thermal power, but hydroelectric resources were expected to play an increasing role by 1982 with completion of the Selingue Dam on the Sankarani River. This new dam, which was begun on November 19, 1976, was to provide about 45 million additional kilowatt-hours; the current production is 76 million kilowatt-hours. The initial cost was estimated at $110 million, and the work was expected to take about 5 years. In 1977, loans for the dam construction were secured from the African Development Bank (ADB), France, and Qatar. The cost of building the 130-kilometer road between Bamako and Selingue was included.

Foreign aid amounted to $227 million in 1977. In addition, credits granted to the Government by the Central Bank in all forms amounted to $197 million at the end of 1977. Among foreign loans[34] made during the year was $4.4 million from the Netherlands for the construction of the 306-kilometer road from Ansongo to Aderambouke. The World Bank, France, and the Canadian International Development Agency (CIDA) contributed funds for modernization of the Regie des Chemins de Fer du Mali (RCFM) and more efficient rail transportation. The United Nations financed two small brick factories at Bamako (12,000 tons per year) and at Segou (8,000 tons per year). The Malian Brick Works, a public enterprise, completed both brick production units in 1977.

Among the mineral industry projects under study were a glassworks, which would utilize clay from Faguibine Lake ($3.6 million); fertilizer plants at Koulikoro and Segou, which would use imported ammonia (to cost $19 million) and phosphates derived from the Bourem phosphate deposit; and expansion of the Malian Cement Co. plant at Diamou near Kayes. The cement plant capacity was to be increased to 100,000 tons per year and would involve financing of about $53 million to be furnished by Saudi Arabia, Japan, and the Federal Republic of Germany. Long-range plans also envisioned the production of aluminum through processing of the Manantali bauxite, and a small electric iron and steel plant supplied by the iron ore of Niono and other western Mali deposits. A second cement plant at Gangouteri, about 40 kilometers from Diamou, was also being considered.

Mineral development in western Mali depended upon progress made in Senegal River Development Organization (OMVS) programs. Studies reporting on the Manantali Dam and its hydroelectric plant, on the construction of the Diama Dam, and on making the Senegal River navigable were passed through the first-reading stage by the OMVS High Commission Council of Ministers. The Manantali Dam, to be located on the Bafing River, was expected to cost about $150 million and would not be ready for service before 1984. Exploitability of the deposits of the Kayes Region was also still under study; mineralization included bauxite, iron ore, and diamond.

Sizable deposits of bauxite, uranium, and iron in western Mali and copper, manganese, platinum, and phosphates in the Liptako-Gourma area were the objects of exploration and feasibility studies. The Government firm, Société Nationale de Recherches et d'Exploitation Minières (SONAREM) was assisted in prospecting operations in both areas by the Soviet Union

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and the German Democratic Republic. French aid was both private and public and included financial as well as technical assistance from the French Aid and Cooperation (FAC) and BRGM. Detailed prospecting and feasibility studies were being done on the bauxite deposits of Balea and Sitaouma, located in proximity to the planned Manantali Dam site. PUK of France was studying exploitation of the Balea deposits. The FAC signed three new agreements in December 1977, including a loan of $380,000 to be spent on studies involving the iron ore deposits of the Bafing-Makana Rivers area; the Balea deposit, located near the Manantali Dam site, is in this area and is estimated to contain 130 million tons of hematite with an iron content of 40% to 65%. The entire basin in which the deposit was located is estimated to contain as much as 500 million tons of iron ore. On the Malian side of the Faleme River (opposite Senegal) another high-grade iron ore deposit was also being studied with financial and technical assistance from the United Nations and France.

BRGM was assisting the Government of Mali in drawing up a minerals plan, while CIDA was assisting with a geophysical survey of the Liptako-Gourma area. The Liptako-Gourma Authority (Mali, Upper Volta, Niger, and Togo) was coordinating studies aimed at a mineral resources inventory of the area. The main prospects under consideration were the manganese ores of Ansongo (3.3 million tons of 40% manganese) and the phosphates of the Bourem area (20 to 25 million tons of 27% P_2O_5). The investment required for developing the Bourem phosphates was estimated at $3.8 million, including facilities for ore extraction at Tamaguelleit in the Tilemsi Valley; transportation of ore to Bourem on the Niger River; and concentration, crushing, and bagging of the product.

The Malian Bureau of Mines and Geology granted uranium exploration concessions to COGEMA (France), BRGM, and a Japanese-financed company, Power Reactor and Nuclear Fuel Development Corp. (PNC). Several U.S. companies were also reported as interested in uranium prospecting. COGEMA held two concessions, located between Kayes and the Senegal border on the west and Sikasso and Upper Volta on the east. BRGM had two areas, one located near the Senegal and Guinea borders adjacent to the COGEMA areas, and the other just south of the PNC area. PNC's concessions were in northeastern Mali near the Algeria and Niger borders. Deposits similar to those of the Hoggar massif in Algeria and the sandstone of Niger were being sought. From initial surveys in the Kidal, Tessalit, and the Tilemsi Valley, PNC estimated the country to have a high potential for discovery of minable uranium deposits. Kenting Earth Sciences Ltd., a Canadian company, had done initial airborne surveys for PNC. On October 5, 1977, PNC sent a 35-man exploration team to conduct the third airborne survey, make geological surveys, and do drilling tests over four selected areas, Ibelbel, Barakoye, Kidal, and Tessalit. About $3.7 million was to be spent on the project. The initial aerial survey in the Kidal concession showed strong radioactivity at seven different locations; of the seven, three were determined as promising from the followup drilling and geological surveys.[35]

A total of 90 Soviet miners and geologists were working at the gold mine in Kalana along with 500 Malian engineers and workers. The Kalana mine was expected to be fully operational by 1980, but would be supplying 400 kilograms of gold per year by 1979. This production was expected to reach 1,790 kilograms per year after 1980. Gold production from various sources in Mali was 29 kilograms in 1977. Prospecting also continued at Kodieran. This gold deposit, located 6 kilometers from Kalana, was expected to be exploited by the end of the current 5-year plan. Cost to develop this deposit was estimated at $6 million. Diamond prospecting also continued in the Kenieba Region.

Several petroleum companies were considering renewal of petroleum prospecting. The French company, Elf-Aquitaine, in particular was requesting exploration concessions near Gao.

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MAURITIUS[36]

The 1977 mineral production contributed $5 million[37] to the GNP, estimated at $666 million at current prices. Minerals produced included salt (6,000 tons) valued at $383,000, lime (7,500 tons) valued at $638,000, and basalt (1,574,000 tons) valued at $4 million. All commodities produced increased in amount and value compared with 1976 levels; basalt production was three times higher than in 1976. Mauritius relied upon foreign trade for about 60% of the GNP but imported most of the raw material used for its export-oriented industries. The value of imports for 1977 rose 22% to $470.7 million, whereas the value of exports rose only by 15% to $325.5 million. About 7,234 barrels of crude oil was imported. Total refined petroleum product imports were valued at $47 million for 1977. Mauritius also imports cement and iron and steel products.

No additional exploration drilling was planned for the immediate future by Caltex Oil Mauritius, which had been carrying out petroleum exploration off the coast of Mauritius. Caltex had drilled two exploratory wells, but no oil was found. A new maritime zones bill was passed in 1977 which established a 200-mile economic resource zone and extended the territorial sea to 12 miles. Exploration and exploitation of the continental shelf were also covered by the new law.

NIGER[38]

Uranium, the major foreign exchange earner and an increasingly important budget source, has firmly established itself as the key to Niger's economic future. Its share of export earnings reached 74% in 1977, rising from some $57 million[39] in 1973 to $148 million in 1977. The estimated GDP was $592 million in 1977, compared with $538 million the previous year. Per capita GDP reached a new high of $119 in 1977 compared with $112 in 1976.

As the Government approached completion of its first development plan (1976-78), programs were underway for a 5-year followup plan (1979-83), which was to emphasize rural development, improvements in health and education services, improved production in the agricultural sector, and industrial expansion. The most acute problem to the broadening economic development of Niger, a landlocked country, remained its dependence on neighboring countries for supplies of petroleum and other raw material. Since railroad links with neighbors seemed still a year away, extensive highway improvements were in the planning stages and all-purpose haulers were given first priority. Foreign investment continued to be encouraged. The investment code, in effect since March 1974, provides for two major grace periods of tax relief and tariff protection (if necessary), allocated according to levels of investment in selected fields (energy production, mineral exploration, agriculture, fertilizer industries, and forestry). Government participation in commercial ventures, while common in Niger, was not required by law. As a member of the West African Monetary Union, Niger shared a common currency with other members. The currency received its stability from its full convertibility with French francs as guaranteed by the French Government. This backing enabled Niger to operate a liberal system of payments and transfers; for example, profits after taxes may be fully repatriated in international transactions.

Uranium production, begun in 1971 in Niger's desolate Air Region, was 1,440 tons in 1977. Estimated reserves exceeded 100,000 tons of uranium, and 16 foreign companies from 9 different countries were participating in exploitation or exploration in 1977. The long-awaited opening of Niger's second uranium mine, Akouta, did not materialize in 1977, but the mine was scheduled to open in the first quarter of 1978. Akouta, the first deep underground mine in Niger, operated by the consortium Compagnie Minière d'Akonta (COMINAK), with Niger, French, Japanese, and Spanish partners, was to produce 200 tons in 1978 and 2,000 tons annually by 1981. Niger's only other uranium mine, Arlit, operated by Société des Mines de l'Air (SOMAIR), produced 1,440 tons in 1977, while employing 600 workers and 90 engineers. A third find

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at Imouraren, which contained greater reserves than any uranium deposit in Niger, was in its final feasibility study stage at the end of 1977. The operators of this deposit, the French Atomic Energy Commission and Niger Government, reportedly were to begin actual mining in 1979, with production of a marketable yellow cake by 1983. All of the companies active in mining, particularly uranium mining in Niger, and those interested in obtaining mining permits were asked by the Niger Government to help finance the $100 million Tabora-Arlit uranium highway. This road would link the isolated north to the commerce-oriented south. All 1977 negotiations indicated that the Government strongly viewed financial support for the highway as a prerequisite to participation in the country's uranium development.

The construction of Niger's new $125 million powerplant, a mixed enterprise of Société Nigerienne du Charbon (SONICHAR), was almost completed at yearend. The Sonichar complex will eventually produce 250 million kilowatt-hours annually, utilizing as feed stock coal from the new deposit near Air. Reportedly 4.5 million tons of coal was already blocked in this deposit.

During the year, Société Minière du Niger (SMN) operated two small tin mines, mostly placer, with 105 tons of total production. Phosphate deposits found to the north of Tahoua remained dormant during the year, because of low-grade and high-beneficiation cost.

RÉUNION[40]

The production of cement was the primary mineral activity in Réunion, an island in the Indian Ocean approximately 640 kilometers east of Madagascar. The clinker-grinding plant operated by Ciments de Bourbon S.A. had an annual capacity of 200,000 tons. It was located in Le Port, southwest of the capital, Saint Denis. BRGM (France) continued ground water surveys and geological mapping of Réunion, which was an overseas territory of France. The country's major development projects, financed largely by France, consisted of infrastructure improvements including road construction, electrification, and port expansion at Pointe des Galets.

RWANDA[41]

Both the quantity and value of Rwanda's mineral production increased during 1977, and mineral exports accounted for more than 20% of the country's foreign exchange. Cassiterite (tin ore) was Rwanda's most important mineral product, and ranked second after coffee in value as an export commodity. Production of tin and tungsten minerals increased only marginally in 1977, but production of columbite-tantalite increased 42% from 45.4 tons in 1976 to 64.4 tons in 1977, and gold recovery increased 115% from 936 to 1,814 troy ounces during the same period.

Most of Rwanda's mineral industry was controlled by the Société MiniÈre du Rwanda (SOMIRWA), managed and 51% owned by Compagnie Géologique et Minière des Ingénieurs et Industriels Belges (Gèomines), and 49% owned by the Rwandan Government. SOMIRWA's output was marketed by Société Générale des Mines (SGM) of Belgium. In December 1977 the Rwandan Government confirmed that SOMIRWA had received a 15-year loan of $3.6 million from the European Investment Bank for construction of a smelting plant at Kigali to produce tin metal and tantaliferous slag from Rwandan ores. Interest on the loan was scheduled at 2% for the first 4 years and 6% for the remaining 11 years.

Rwanda's chief export route through Uganda to the Kenyan port of Mombasa on the Indian Ocean continued to carry most of the imported supplies, including motor fuel, required for the mining industry. Delays in delivery of goods on this 1,800-kilometer route, aggravated by complications and weight restrictions at two Ugandan frontier crossings, caused intermittent fuel shortages in Rwanda. Air charter firms transported one-third of Rwanda's coffee exports from Kigali to Mombasa and returned with high-cost or urgently needed imports, in-

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cluding cement, at discount rates when extra space was available. All of Rwanda's wolframite and some of its cassiterite were exported to Brussels by air. The road from Kigali to the Rusumo Falls bridge across the Kagera River at the Tanzanian border was in good condition, but its connection to the Tanzanian railroad at Isaka was virtually impassable for trucks. Reconstruction continued on the Rwandan portion of an alternative export route through Bujumbura, the Burundian port on Lake Tanganyika, which involves lake steamer to Kigoma followed by rail across Tanzania to Dar es Salaam.

The Economic Community of the Great Lakes Countries (CEPGL) continued to investigate the development of hydroelectric potential for the mutual benefit of Rwanda, Burundi, and Zaire, with financial assistance from the Banque Arabe de Developpement (BADEA). The European Development Bank also provided assistance for a joint Zaire-Rwanda project for increased recovery of methane gas from Lake Kivu. Methane from the lake continued to be used as the source of heat and power at Brasirwa, the state-owned brewery.

On August 24, 1977, the Rwandan, Burundian, and Tanzanian heads of state established an Organization for Improvement and Development of the Kagera River Basin, in collaboration with the UNDP. One objective was to increase mining activities in an area of 67,000 square kilometers, including eastern Rwanda and adjacent parts of Burundi, Tanzania, and Uganda.

SAO TOMÉ E PRINCIPE[42]

The Democratic Republic of São Tomé and Principe, with a total area of less than 1,000 square kilometers and fewer than 80,000 inhabitants, became Africa's smallest nation in July 1975. Portuguese continued as the official language of the two islands, located 400 and 250 kilometers, respectively, southwest of the Isle de Macias Ngnema Biyogo (formerly Fernado Po) in the Gulf of Guinea off Africa's Atlantic coast. The country's preindependence GNP was estimated at $19.4 million, and its 1976 export and import trade was reported at $6.5 million and $6.9 million, respectively. A new monetary unit, the dobra, replaced the escudo on September 8, 1977, at the rate of US$1.00=38.3 dobras. Agriculture and fishing were the principal industries, but the traditonal manufacture of bricks and tiles from local clay and their use together with sand and stone for local buildings has presumably continued. Oil concessions reportedly were being renegotiated by Ball and Collins (Oil and Gas) Ltd. of London, but there was no record of recent exploratory work.

SENEGAL[43]

The growth rate of the Senegalese economy slackened in 1977 owing to depressed markets for its major export commodities, phosphates and ground nut oil. Total exports from Senegal's two phosphate operations, at Taiba and Thiès, were 1.6 million tons. The two operating companies, Compagnie Sénégalaise des Phosphates de Taiba (CSPTI) and the Société Sénégalaise des Phosphates de Thiès (SSPTH), were owned 50% by the Government and 50% by several European enterprises.

In mid-1977 the Senegalese Government announced a decision to postpone development of the Tobène phosphate deposit, with a reported 50 million tons of ore, until the reserves at the adjacent Taiba mine were exhausted. Beginning in 1978, Taiba's phosphate rock production was to be expanded to 2.1 million tons per year; at this level of production the deposit's life expectancy is 12 years. To implement this expansion, CSPTI purchased a $10 million[44] dragline from overseas, which was slated for delivery during 1978. It was also announced that the Iranian Government was to purchase 25% of CSPTI's stock, amounting to some $12 million. Recipients of Senegalese phosphate, in the order of tonnage volume, were France, the United Kingdom, the Federal Republic of Germany, and the Ivory Coast.

A new company, Industries Chimiques de Senegal (ICS), was organized in 1977 with the following share holders: The Senegalese

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Government, 25%; Entreprise Minière et Chimiques, 25%; Société Industrielle d'Engrais Senegal, 15%; the Polish Chemical Export Agency, 10%; CSPTI, 10%; Rhône-Poulenc Thiès, 7.5%; and Eau et Électricité de l'Ouest Africaine, 7.5%. A total of $50 million was earmarked for investment in this project, which is expected to produce 500 tons per day of P_2O_5. Furthermore, this P_2O_5 will be used in the manufacture of triple superphosphate and diammonium and monammonium phosphate for export. The plant is expected to go onstream by mid-1981.

The feasibility studies that were started in mid-1976 to study utilization of iron ore mines in the eastern Kedougon-Saraya District continued during the year. Preliminary results indicated that remoteness of the iron ore deposit and inaccessibility were the major deterrents to the development of this commodity. The companies involved in the iron ore venture were Fried. Krupp GmbH (Federal Republic of Germany), 24%; BRGM (France) 24%; Kanematsu Gosho Ltd. (Japan), 24%; and the Senegalese Government, 28%.

Also, the results of the feasibility studies on the beach sand deposits on the east coast revealed that the percentage of titanium minerals was not high enough to warrant even a small-scale operation during the year. A Government company was organized to develop marble deposits in southeastern Senegal near Kedongar. The company was slated to produce about 10,000 tons of marble per year for export by 1982. In addition, the company will produce enough marble to satisfy domestic demand, thus eliminating imports from abroad. The company was conducting a market search in the international area, specifically Europe, for its varigated varieties of marble in 1977. Total production of cipoline marble was 5,000 cubic meters.

Oil and Gas.—About 100 million tons of heavy crude oil discovered at the 200-meter depth offshore, 60 kilometers west of the mouth of the Casamance River, remained untapped at yearend and the result of the feasibility study by a Venezuelan oil company to reevaluate this deposit was not yet available. Chevron Oil Co.'s exploration for oil 50 kilometers north of Dakar did not reveal a substantial finding; however, the company was planning further search in 1978.

The only petroleum refinery in Senegal, Société Africaine de Raffinage, located at M'Boa near Dakar, processed about 765,000 tons of crude oil during the year. Its capacity of 800,000 tons per year was sufficient to meet domestic needs and to export about 20% of the production to Mauritania and Mali.

SEYCHELLES ISLANDS[45]

The Government of Seychelles prepared and published its First National Development Plan (1977-81). The main objectives of the plan included economic viability, diversification of the economy, and greater Seychellois participation in the economy. Following the 1977 coup, a more socialist plan was promised. A census taken in 1977 indicated that the Seychelles Islands number approximately 100 in total, of which 40 are granitic and 60 coralline. The total population was nearly 62,000, and 4,244 persons were employed in mining and construction. The only mineral product mined was guano. In 1977, 5,277 tons of guano valued at $181,000[46] was produced.[47] Plans for development of other minerals included quarrying granite for export and petroleum exploration.

The Seychelle Islands were elected to membership in the Afro-Malagasy-Mauritian Common Organization (OCAM), an organization based on cultural and economic cooperation among French-speaking African countries. The Seychelles was the 11th member of the organization. Also during 1977, the Government of Seychelles promulgated a new law redefining the nation's territorial sea and exclusive economic zone, which was defined as the area beyond and adjacent to the territorial waters extending to a distance of 200 miles. The act also defined the continental shelf and enumerated Seychelles rights with respect to this area.

Petroleum exploration offshore the Seychelles Islands began with an agreement signed in 1977 by a group headed by Burmah Oil Seychelles (40%) as operator. Partners in the Burmah Oil group were Amoco Seychelles Petroleum (20%), Hematite Petroleum Seychelles (20%), and Norcen

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International (20%). The exploration license covered 24 blocks over an area of 16,000 square kilometers. In addition, the Government concluded exploration agreements with Siebens Oil and Gas of Canada (16 blocks, totaling 10,956 square kilometers) and with Oxoco International of the United States (5 blocks, totaling 3,482 square kilometers). Terms provide for state participation of up to 50% in successful finds and fees totaling over $500,000 for the exploration rights. In addition to bonuses and annual rentals, a 12.5% royalty on oil produced and a petroleum income tax rate of 55% would be imposed.

SOMALIA[48]

The mineral industry of Somalia contributed minor value to the economy of the country in 1977. Production was limited to local building materials, marine salt, meerschaum, and small amounts of cassiterite. Neither production nor detailed trade figures were available. Marine salt was recovered by solar evaporation at Hafun in northeastern Somalia.

The Government's 5-year Development Plan (1974-78) continued toward fulfillment with foreign aid accounting for 67% of financing. The plan's $620 million[49] expenditure was primarily aimed at agricultural development, but 19% was destined for industrial development. The United States had resumed economic development aid to Somalia by yearend 1977 and was expected to submit to the U.S. Congress a proposal for an agricultural research and training program for Somalia in 1978. The United States had terminated development funds to Somalia in 1971. However, Somalia has received humanitarian aid and grants from the United States since 1971 largely because of an extended drought.

Geological surveys were conducted during 1977 by the UNDP, which in previous years had identified deposits of uranium, thorium, and yttrium. Uranium deposits, amenable to open pit mining, were found in the Bur Region of the Alio Ghelle area, 190 kilometers northwest of Mogadiscio. The carnotite reserves were estimated to exceed 5,000 tons of uranium oxide ore with an average grade of 0.07% uranium oxide.

Construction of the Berbera cement plant with a 100,000-ton-per-year capacity continued during the year. Limestone, clays, and gypsum were to be supplied locally from the Berbera Region. An asbestos cement plant in Berbera with a capacity of 22,000 tons per year began production in late 1976.

Construction continued on the Mogadiscio petroleum refinery. The refinery with a capacity of 10,000 barrels per day (500,000 tons per year) was scheduled to come onstream in late 1978. The Iraqi Fund for Foreign Development financed the project, and the Iraq National Oil Co. agreed to supply the crude oil for the refinery. Somalia relied on imports of petroleum products from the Soviet Union and Iraq to satisfy its domestic demands in 1977.

The African Development Fund granted a loan to Somalia for approximately $5.6 million for infrastructure development. The loan was to finance the construction of a 100-kilometer, two-lane asphalt road from Hargeisa to Boroma, as well as the expansion of the Somali Office of Civil Engineering. The total cost of the project was estimated at $30 million, of which 76% was provided in foreign exchange and 24% in local currency. The Arab Fund for Economic and Social Development (AFESD), the International Development Association (IDA), the Islamic Development Bank, and the Government contributed capital for the project. The EDF and the AFESD agreed to jointly finance the construction of a 248-kilometer road linking Mogadiscio and Kimango. Expansion of the deep water port at Mogadiscio was completed. The new port was to furnish a route into Mogadiscio for shipments which formerly were processed through Merca. The total cost of the project was over $25 million. The new port included a 2,300-foot breakwater, access road, depots, and warehouses.

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SWAZILAND[50]

The value of Swaziland's mineral production decreased from $28 million[51] in 1976 to approximately $27 million in 1977 owing largely to reduced iron ore sales. The mining sector has declined in relative importance in the Swaziland economy, and its contribution to national income has decreased to about 12%. The major mineral commodity in terms of revenue was asbestos, which accounted for 64% of mineral value. Iron ore (28%) and coal (6%) were the other important mineral commodities. Kaolin and barite operations closed down in 1976, and iron ore mining ceased in 1977. Tin and gold mining were to resume on a moderate scale, and activity in industrial minerals was likely to increase. The Geological Survey and Mines Department played an important role in prospecting for coal, tin, gold, and industrial minerals and in supervising small-scale mining operations.

Construction began on the rail link to connect the Swaziland Railroad to Richards Bay in the Republic of South Africa. The 90-kilometer section between Phuzumoya and Lavumisa would integrate Swaziland with the South African railroad system and facilitate the expansion of mineral operations. The country has been dependent on a single rail outlet to Maputo in Mozambique through which 80% of Swaziland's exports passed. Opening of the alternative transport route was scheduled for early 1979.

In 1977, Swaziland formed its first shipping company, the Royal Swaziland Maritime Co. Ltd. Leaving from the ports of Durban in the Republic of South Africa and Maputo, three chartered vessels were to carry cargo to Western Europe via the Suez Canal. The shipping company was investigating the purchase of additional carriers.

The Ngwenya iron mine produced about 1.4 million tons of 60% iron ore in 1977 compared with 1.7 million tons in 1976. The mining operation was closed in October 1977 owing to the depletion of the high-grade ore body, but shipments of stockpiled fines were to continue until March 1979. Production was exported to Nippon Steel Corp. in Japan under a contract for the supply of 6 million tons of medium-grade ore. Rail transport and loading facility problems at Maputo prevented the Swaziland Iron Ore Development Co. Ltd. (SIODC) from meeting its contractual target of 2 million tons per year. SIODC was owned 60% by Anglo American Corp. of South Africa Ltd. and 20% by the Swaziland Government.

High-grade iron ore at Ngwenya was depleted in 1974, and middle-grade ore was mined until 1977. The utilization of the country's large resources of low-grade ore was under study by the Government. Total iron ore reserves were estimated at 576 million tons with an average iron content of 34%. In 1977, the Government contracted Belgian consultants to conduct a feasibility study for a pellitization plant, which would use domestic coal in iron ore reduction.

Havelock Asbestos Mines (Swaziland) Ltd. produced approximately 38,000 tons of chrysotile fiber in 1977. The underground mine had a capacity of 2,800 tons of ore (120 tons of asbestos fiber) per day. Plans were underway for sinking an incline shaft to mine the deeper ore levels. The company recently enlarged and modernized the mill's recovery unit for short fiber. Production from the Havelock mine, which began operations in 1939, was exported, largely to the United Kingdom. Shareholders in the mine were the Swaziland Government (40%) and Turner and Newall Ltd. (United Kingdom) (60%).

Production of coal by Swaziland Collieries Ltd. at Mpaka decreased to 128,990 tons in 1977. Output supplied the Swaziland Railroad, local industrial and agricultural demands, and a small export market. Swaziland Collieries was a subsidiary of Anglo-American. The Swaziland Government continued in its attempts to encourage greater domestic use of coal and to secure long-term markets abroad. Studies proceeded on the feasibility of constructing a thermal power station based on expanded coal production from the Mpaka District.

Exploration continued in Swaziland's coalfield, which extended over a distance of 150 kilometers in a north-south direction between Bordergate and Pongola in the Lowveld. Reserves were last estimated at 224 million tons of anthracite. In 1977, it was reported that Johannesburg Consolidated Investment Co. Ltd. (JCI) was conducting feasibility studies on a 600,000-ton-per-year mine based on coal reserves at Maloma. Shell Coal (Swaziland) Pty. Ltd. also located substantial reserves of coal in its prospecting area north of Mbabane. Drilling was to continue in 1978 to investi-

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gate ground conditions and obtain bulk samples.

Both barite and kaolin operations were closed in 1976. Swaziland Barytes Ltd., which produced approximately 10,200 tons of barite since opening in 1945, closed owing to bankruptcy. Kaolin (Swaziland) Pty. Ltd. ceased mining at Mahlangatsha owing to depletion of the ore body. The Government evaluation of kaolin deposits near the old mine showed over 100,000 tons of kaolin amenable to shallow open pit mining and another 50,000 tons for underground mining. Further studies were to be conducted.

Approximately 2.2 tons of 73% tin concentrates was produced at the tin mine at Sinceni in 1977. The residual tin mines have been worked on a small scale since the late 19th century. Studies were being conducted by the Federal Republic of Germany regarding the exploitation of cassiterite deposits in the Kubuta area. The final report and recommendations were to be completed in 1978.

The gold leaching operation at Red Reefs produced 4,147 troy ounces in 1977. Deposits at Piggs Peak, the major gold producer in the 19th century, were to possibly be reopened under Government supervision. Eland Exploration (Pty.) Ltd. was granted an exclusive prospecting license in 1977 over portions of the southern part of the Greenstone Belt, with work to be extended to the Piggs Peak mine area in 1978.

Swaziland had one clinker-grinding plant operated by Matola Cement Co. The plant, which was located at Matsapa, produced about 70,000 tons of cement per year. Approximately 33,000 tons of granite was produced at the Van der Meer quarry and sold for use in the domestic construction industry. Production increased over the 20,000 tons produced in 1976, owing to new projects in road and railroad construction.

Fertilizer production at the Matsapa plant was about 3,252 tons of nitrogenous products, marketed largely in Swaziland and the Republic of South Africa. Operated by Swaziland Chemical Industries (SCI), the plant used imported ammonia and phosphoric acid as feedstock. A $3.8 million expansion project was to provide the plant with its own bulk-blending and granulation units.

TOGO[52]

Togo's known mineral wealth in 1977 consisted of extensive reserves of high-grade phosphate rock, which were exploited by Cie. Togolaise des Mines du Bénin (CTMB). In both 1976 and 1977, phosphate exports provided approximately half of all of the country's export earnings. Production, which was roughly 2.1 million tons in 1976, increased to 2.8 million tons in 1977. Export earnings for 1977 were estimated at about $92 million. Office Togolaire des Phosphates (OTP), the marketing organization, was successful in 1977 both in diversifying sales and in expanding existing markets. West Europe remained the largest regional market, taking 1.8 million tons. The greatest expansion in the Togolese phosphate market, however, occurred in East Europe, primarily in Czechoslovakia, Poland, and Romania. Outside Europe, deliveries were made to Japan, the Republic of Korea, and Nigeria.

Phosphate rock produced from the open-cast mines in the Kahotoe and Kpogame areas was treated at the Kpeme plant, which has a capacity of 70 tons per hour, or 2.5 to 3 million tons of concentrate per year. Plant expansion, underway during 1977, was to increase this capacity to 4 million tons by 1980. In order to move toward semimanufactured phosphate rock products, the Government completed in 1977 a feasibility study for a phosphoric acid fertilizer plant. Under this plan, which is to cost $300 million, CTMB would be able to market finished fertilizer material, phosphoric acid, and phosphate concentrate.

Exploration work on uranium occurrences between Bénin and Togo's border continued during the year. Uranerzbergbau, a West German uranium firm, and Wyoming Mineral Corp. of U.S.A. extended their geophysical and geochemical work to the east of Laakara during the year. However, by yearend no results were published.

The construction of a small steel plant in the Port Industrial Zone continued during the year. Upon completion, the plant would consist of an electric furnace with an initial steel capacity of 20,000 tons per year and a rolling mill with a capacity of 40,000 tons per year. Feed material for the plant initially was to be scrap and later iron ore from indigenous deposits. These iron ore deposits,

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located nearly 100 kilometers away near Bassar in north-central Togo, had no railroad connection and no infrastructure. Also, a thermal plant with a 115-megawatt capacity to supply energy for the steel plant was in the construction stage. The steelworks and powerplant were owned by the Togolese Government and were to be operated by the Société Nationale de la Sidérurgie with financing of both projects by a group of European banks.

Oceanic Resources Ltd., a subsidiary of Oceanic Exploration Co. of U.S.A., continued mapping and exploration efforts on the Upper Volta River basins during the year. The company's concession rights include 580,000 acres offshore and 1.4 million acres onshore. The Lane petroleum refinery, built by two British firms (Humphrey and Glasgow and Civilian Press International), started production during 1977 and was to be officially inaugurated by 1978. The refinery, with a 1-million-barrel annual crude oil capacity, was to be connected by a 28-kilometer-long pipeline to an oil port. The refinery will be operated by Togolese Hydrocarbon Co. in which the Libyan Government holds 40% of the capital. Total cost of refinery was given as $90 million.

The construction of the Togo-Ghana-Ivory Coast clinker plant known as Ciments de l'Afrique de l'Ouest (CIAMO) proceeded on schedule. The plant was to produce 1.2 million tons of clinker per year with a possibility of doubling this capacity later on. The initial production date was given as the early 1980's.

UGANDA[53]

The mineral industry of Uganda continued to play a minor role in the nation's primarily agrarian economy in 1977. Information was not available on many sectors of Uganda's economy, including mining. However, mining contributed less than 1% to the GDP, and the total value of mineral products was estimated at $14 million.[54]

Copper retained its position as the most important mineral product, followed by cement, cassiterite, apatite, bismuth, wolframite, and columbite-tantalite concentrate. Production of building materials, clays, sand, stone, gravel, and salt undoubtedly took place for domestic consumption.

In 1977 Uganda began building a facility with West German financial and technical aid to utilize Lake Katwe brines for the production of table salt and muriate of potash. Production was to commence late in 1978 at an initial rate of 50,000 tons per year of sodium chloride and 17,000 tons per year of potassium chloride.

Table 4.—Uganda: Exports and reexports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum metal, scrap	24	14
Copper metal including alloys:		
Scrap	69	313
Unwrought	7,762	5,366
Iron and steel semimanufactures:		
Bars, rods, angles, shapes, sections	71	--
Tubes, pipes, fittings	29	--
Lead metal, scrap	31	--
Tin ore and concentrate	85	20
Tungsten ore and concentrate	229	96
Zinc metal, scrap	13	--
Other ores and concentrates of base metals, n.e.s	96	40
NONMETALS		
Cement	120	200
Clays and clay products, nonrefractory	8	--
Fertilizer materials:		
Crude, phosphatic	17	--
Manufactured:		
Nitrogenous	40	--
Phosphatic	3,403	--
Salt and brines	123	350
Sulfuric acid, oleum	603	--
Other nonmetals, crude, n.e.s	31	--

See footnotes at end of table.

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Table 4.—Uganda: Exports and reexports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline	thousand 42-gallon barrels	12	1
Kerosine	do.	([2])	1
Jet fuel	do.	1	12
Distillate fuel oil	do.	([2])	22
Other: Bitumen and other residues	do.	([2])	--

[1]Includes transfers to Kenya and Tanzania.
[2]Less than 1/2 unit.

Table 5.—Uganda: Imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS			
Aluminum metal including alloys:			
Unwrought	value	$1,142	--
Semimanufactures		[2]470	116
Copper metal including alloys, semimanufactures		[3]28	[3]48
Iron and steel metal:			
Ferroalloys		--	130
Steel, primary forms	value, thousands	$1	([4])
Semimanufactures:			
Bars, rods, angles, shapes, sections		1,272	873
Universals, plates, sheets		4,167	1,437
Hoop and strip		98	180
Rails and accessories		768	361
Wire		559	586
Tubes, pipes, fittings		4,012	295
Castings and forgings, rough		11	--
Lead metal including alloys:			
Unwrought		--	2
Semimanufactures		20	5
Nickel metal including alloys, semimanufactures	value	$436	$2,669
Platinum-group metals including alloys, all forms but not rolled	troy ounces	([4])	--
Tin metal including alloys:			
Unwrought	value	$1,872	$840
Semimanufactures		109	51
Zinc metal including alloys:			
Unwrought		167	104
Semimanufactures		[5]2	--
Other:			
Base metals including alloys, all forms, n.e.s	value	--	$65
Pyrophoric alloys	do.	$21	--
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc		1	--
Grinding and polishing wheels and stones	value	$7,004	$5,517
Asbestos		28	147
Cement		401	1,019
Chalk	value	$10,579	$1,885
Clays and clay products (including all refractory brick):			
Crude		75	108
Products:			
Refractory (including nonclay brick)		568	597
Nonrefractory		512	54
Diatomite and other infusorial earth		6	29
Feldspar and fluorspar		485	--
Fertilizer materials:			
Manufactured:			
Nitrogenous		170	6,318
Phosphatic		--	79
Potassic		350	--
Other, including mixed		3,055	--
Ammonia		61	--

See footnotes at end of table.

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Table 5.—Uganda: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS —Continued			
Graphite, natural		--	2
Gypsum and plasters		3,186	163
Lime		221	--
Mica, worked, including agglomerated splittings	value	$1,173	$41
Pigments, mineral, natural, crude	do	$23,537	$396
Salt and brines		17,165	14,345
Sodium compounds, n.e.s.:			
Caustic soda		1,474	--
Sodium carbonate (soda ash)		104	10
Stone and sand and gravel:			
Dimension stone		75	5,290
Dolomite, chiefly refractory grade		267	203
Gravel and crushed rock, n.e.s		1,020	41
Limestone (except dimension)		--	1
Quartz and quartzite		(4)	2
Sand, excluding metal bearing		(4)	--
Sulfur:			
Elemental		687	17
Sulfuric acid and oleum		12	4
Talc, steatite, soapstone, pyrophyllite	value	$486	$2,440
Other nonmetals, crude, n.e.s	do	$15,190	--
MINERAL FUELS AND RELATED MATERIALS			
Coke and semicoke		1	200
Petroleum refinery products:			
Gasoline	thousand 42-gallon barrels	1,061	6
Kerosine	do	390	22
Jet fuel	do	302	1
Distillate fuel oil	do	628	--
Residual fuel oil	do	393	--
Lubricants	do	68	7
Other:			
Liquefied petroleum gas	do	30	--
Nonlubricating oils, n.e.s	do	2	2
Mineral jelly and wax	do	8	3
Bitumen and other residues and bituminous mixtures, n.e.s	do	20	(4)
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		2	194

[1]Includes transfers from Kenya and Tanzania.
[2]Excludes quantities valued at $6,475.
[3]Excludes quantities valued at $1,277 in 1975 and $1,578 in 1976.
[4]Less than 1/2 unit.
[5]Excludes quantity valued at $2,831.

UPPER VOLTA[55]

An arid, landlocked country where industrialization and urbanization were minimal, Upper Volta had no significant mineral production in 1977. Plans for mineral development were being pursued, however. The second 5-year plan (1977-81) was to allot 21% of the development expenditures to the Tambao mine and railroad, the Poura gold mine, and the Tin H'Rassan cement plant. The manufacturing and industrial sector accounted for about 36% of the GNP, which was valued at $700.4 million[56] and represented a growth rate of 16.9% compared with the 1976 value. The average rate of inflation was 12% over the last 5 years.[57]

The overall investment climate of Upper Volta was considered favorable owing to the stable government. The Upper Voltans had a liberal investment code, which granted tax and customs exemptions up to 25 years in certain cases, afforded tariff protection, eased foreign currency restrictions, and guaranteed arbitration. Upper Volta was also pursuing a policy designed to increase Voltan control of vital domestic business and financial activities. In large enterprises, Voltans must own at least 51% of the stock. In 1977, the process of complete transition to civilian rule in Upper Volta was started. A new constitution, establishing three branches of government (executive, legislative, and judicial) after the French model, was approved on November 27, 1977. Presidential elections were to be held in April and May of 1978.

Upper Volta experienced a trade deficit in 1977 with imports, valued at $237 million, far exceeding exports, valued at $89 million. Petroleum imports were valued at $11.3 million in 1976, and were estimated to

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comprise 6% of the total 1977 import value. Upper Volta received a balance-of-payments support loan of $2.25 million in 1977 from the Organization of Petroleum Exporting Countries (OPEC) special fund. Upper Volta was a member of several international trading and economic unions, including the West African Economic Community (CEAO), the Economic Community of West African States (ECOWAS), and the African and Malagasy Common Organization (OCAM).

Upper Volta was also a participant in the Authorite de Developpement Integre de la Region du Liptako-Gourma, an organization formed to foster mineral, industry, and infrastructure development in the region that includes Mali, Niger, Togo, and Upper Volta. The Liptako-Gourma development program was calling for investments of $1 billion, which would enable exploitation of the region's resources. The project also called for an extension of the Togolese railroad to Upper Volta and Niamey, Niger, and then to Mali, following the course of the Niger River. A survey commission was to be set up to study this proposal. The Inter-African Mining Commission was established in 1977 to undertake technical economic assessment of the area. Projects under immediate assessment included the phosphate deposits of eastern Upper Volta, of Bourem in Mali, and of the "W" region of Niger; the manganese deposits of Ansongo and Ofalikin in Mali and of Tera in Niger; the iron deposits of Say in Niger and of the Buem basin in northern Togo; and the kaolin clay and pink granite of northern Togo. Canada made a loan of $2.3 million for geophysical prospecting in the Liptako-Gourma area for exploration drilling equipment and for construction of the Beli Dam for water at Tambao.

Transportation problems were of primary importance in the nation's development plans. The country had fewer than 700 kilometers of paved roads. The ocean ports in Ivory Coast, Ghana, and Togo that serviced Upper Volta were more than 700 kilometers from Ouagadougou, so that transportation costs were always high. Establishment of a new railroad was also vital to the development of the Liptako-Gourma area and the Tambao manganese deposit. However, the Tambao project was further delayed in 1977 by the withdrawal of Union Carbide Corp., which had a 7% share in the mining consortium. Funding for the Fada N'Gourma, Upper Volta, to Niamey, Niger, road was secured during 1977. The African Development Fund financed about $6.7 million for construction of the road from Dori to Djibo.

Airborne geophysical prospecting was being carried out by Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) of the Federal Republic of Germany for diamond in the Banfora area, and the UNDP was systematically exploring 70,000 square kilometers north of Ouagadougou. The UNDP had made $2.3 million available for mineral research in Upper Volta. Special attention was to be given to the Boromo and Hounde areas, where gold, copper, lead and zinc, and molybdenum occurrences were located. This program had revealed indications of copper near Wayen and lead-zinc near Garango. A new stibnite deposit was reported at a locality 100 kilometers from Ouagadougou and 30 kilometers from the new railroad. Reserves of 30,000 tons of stibnite ore were indicated. The copper deposits near Gaoua, containing 40 million tons of 0.8% copper and 2 grams per ton of gold, were under study by the UNDP. The phosphates of the eastern region (Arly, Kodjari, and Aloud Djouama) were estimated at 250 million tons of 30% P_2O_5. The ore was reported as friable, containing no quartz, and mostly oolitic phosphatic pellets, and as being amenable to open pit mining. Several firms were also exploring for uranium.

A nickel deposit was located about 30 miles west of Koudougou at Bongo. Reserves were estimated at 30 to 70 million tons of nickel laterite containing 1.5% to 3% nickel. The deposit was located less than 8 kilometers from the railroad between Ouagadougou and Abidjan. One of the first drill holes in the 6-square-kilometer area indicated a shallow deposit grading 2.5% nickel over approximately 14 meters. The joint UNDP-Government exploration team was continuing preliminary investigations of the deposit.

The Poura gold mine was under development with reopening scheduled for 1978 by Société de Recherches et d'Exploitations Minières (SOREMI). The capital for SOREMI was distributed among the Government (34.1%), BRGM of France (22.9%), the Société des Mines et des Produits Chimiques (SMPC) (32.4%), the Consultancy and Development Co. (7.5%), and miscellaneous participants (3.1%). An increase in capital was anticipated, which would bring Upper Volta's share to 51%. The workable reserves were currently estimated at 15 tons of gold for the gold-bearing quartz vein (15 grams

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per ton of ore) and 400 kilograms of gold for the workable dumps of the old mine (1.36 grams per ton). The mine had not been worked since 1966.

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[1]Prepared by Candice Stevens, economist.
[2]Where necessary, values have been converted from Communauté Financière Africaine Francs (CFAF) to U.S. dollars at the rate of CFAF238 = US$1.00.
[3]Prepared by T. John Rowland, Jr., physical scientist.
[4]Where necessary, values have been converted from Burundi francs (FBu) to U.S. dollars at the rate of FBu90 = US$1.00.
[5]Prepared by David E. Morse, physical scientist.
[6]Prepared by David E. Morse, physical scientist.
[7]Prepared by T. John Rowland, Jr., physical scientist.
[8]See footnote 2.
[9]Prepared by David E. Morse, physical scientist.
[10]Prepared by Candice Stevens, economist.
[11]Prepared by Candice Stevens, economist.
[12]See footnote 2.
[13]Prepared by Candice Stevens, economist.
[14]Where necessary, values have been converted from Djibouti francs (DF) to U.S. dollars at the rate of DF166 = US$1.00.
[15]Prepared by Miller W. Ellis, physical scientist.
[16]Prepared by Candice Stevens, economist.
[17]Where necessary, values have been converted from Ethiopian birr (Br) to U.S. dollars at the rate of Br2.09 = US$1.00.
[18]Prepared by David E. Morse, physical scientist.
[19]Where necessary values have been converted from Gambian delasis (GD) to U.S. dollars at the rate of GD1 = US$0.49.
[20]Prepared by David E. Morse, physical scientist.
[21]Where necessary, values have been converted from Guinea syli (Gs) to U.S. dollars at the rate of Gs21.25 = US$1.00.
[22]Prepared by David E. Morse, physical scientist.
[23]Where necessary values have been converted from Bissau escudos (Be) to U.S. dollars at the rate of Be40.643 = US$1.00.
[24]Prepared by E. Shekarchi, supervisory physical scientist.
[25]See footnote 2.
[26]Prepared by T. John Rowland, Jr., physical scientist.
[27]Lesotho was a member of the Southern Africa Monetary Union. Where necessary, Lesotho's currency, the South African rand (R), has been converted to U.S. dollars at the rate of R1 = US$1.15.
[28]Prepared by David E. Morse, physical scientist.
[29]Where necessary values have been converted from Malawi kwacha (MK) at the rate of MK1 = US$1.16.
[30]Prepared by Janice L. W. Jolly, physical scientist.
[31]Where necessary, values have been converted from Malian francs (MF) to U.S. dollars at the rate of MF470 = US$1.00.
[32]U.S. Embassy, Bamako, Mali. State Department Telegram 4804, Oct. 2, 1978, 1 p.
[33]U.S. Embassy, Bamako, Mali. State Department Airgram A-17, Aug. 11, 1978, 6 pp.
[34]Marches Tropicaux et Mediterraneens (Paris). Economic Statistics Given for 1977-1978. July 7, 1978, pp. 1867-1868.
[35]Metal Bulletin Monthly (London). Mines Report. No. 79, July 1977, p. 53.
[36]Prepared by Janice L. W. Jolly, physical scientist.
[37]Where necessary, values have been converted from Mauritian rupees (MauRs) at the rate of MauRs6.69 = US$1.00.
[38]Prepared by E. Shekarchi, supervisory physical scientist.
[39]See footnote 2.
[40]Prepared by Candice Stevens, economist.
[41]Prepared by Miller W. Ellis, physical scientist.
[42]Prepared by Miller W. Ellis, physical scientist.
[43]Prepared by E. Shekarchi, supervisory physical scientist.
[44]See footnote 2.
[45]Prepared by Janice L. W. Jolly, physical scientist.
[46]Where necessary, values have been converted from Seychelles rupees (SR) to U.S. dollars at the rate of SR1 = US$0.137
[47]U.S. Embassy, Nairobi, Kenya. State Department Airgram A-12, May 18, 1978, 1 p.
[48]Prepared by T. John Rowland, Jr., physical scientist.
[49]Where necessary, values have been converted from Somalian shillings (Ss) to U.S. dollars at the rate of Ss6.2327 = US$1.00
[50]Prepared by Candice Stevens, economist.
[51]Where necessary, values have been converted from Swaziland emalangeni (E) to U.S. dollars at the rate of E = US$1.15.
[52]Prepared by E. Shekarchi, supervisory physical scientist.
[53]Prepared by David E. Morse, physical scientist.
[54]Where necessary, values have been converted from Ugandan shillings (Ush) to U.S. dollars at the rate of Ush7.95 = US$1.00.
[55]Prepared by Janice L. W. Jolly, physical scientist.
[56]See footnote 2.
[57]U.S. Department of State. Background Notes, Upper Volta. January 1979, 5 pp.

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The Mineral Industry of the Islands of the Caribbean

By Doris M. Hyde[1]

CONTENTS

	Page		Page
Bahamas	1131	Jamaica	1141
Barbados	1131	Martinique and Guadeloupe	1145
Bermuda	1135	Netherlands Antilles	1146
Cuba	1135	St. Lucia	1147
Dominican Republic	1138	Trinidad and Tobago	1148
Haiti	1139		

BAHAMAS

The Bahamas Oil Refining Co. (BORCO) refinery in Freeport continued to operate at less than half its full 500,000-barrel-per-day capacity. Although owned through subsidiaries by the Carey Energy Corp. (65%) and Standard Oil Co. of California (35%), BORCO is ineligible for participation in the Crude Oil Entitlements Program granted to companies operating within the United States proper or its territories. Like some other Caribbean refineries, BORCO has suffered a loss of normal market outlet due to the cost advantage afforded U.S. refineries by the Entitlements Program. Saudi Arabia, Nigeria, and Libya are the major suppliers of crude for the refinery. Its principal products, motor spirits, aviation fuel, distillate fuels, and residual fuel oils, were marketed in the United States and Puerto Rico.

The Government-owned Bahamas Development Corp. and Burmah Oil Co. Ltd., held discussions pertaining to a renegotiation of Burmah Oil's management contract for the Grand Bahama Oil Transshipment terminal. The desired contract modifications were not made public but financial problems have plagued the terminal and its operation since construction started in 1972.

Despite some offshore potential there still has been no petroleum exploration activity in the Bahamas. Appropriate legislative action to update the Petroleum Act of 1971 is expected during 1978.

As previously announced, Bahama Cement Co. closed operations at midyear, after which the Bahamas ceased being an exporter of cement.

BARBADOS

The economy of Barbados experienced a 5% increase in real growth during 1977. This was only slightly less than that obtained during 1976. The mineral industries remained of minor economic importance, limited to some crude oil, natural gas,

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Table 1.—Islands of the Caribbean: Production of mineral commodities

Area, commodity, and unit of measure[1]	1975	1976	1977[p]
ANTIGUA[2]			
Petroleum refinery products:			
Motor gasoline ---- thousand 42-gallon barrels	e255	NA	NA
Kerosine ---- do	e54	NA	NA
Distillate fuel oil ---- do	e187	NA	NA
Residual fuel oil ---- do	e566	NA	NA
Other, including refinery fuel and losses ---- do	NA	NA	NA
Total ---- do	e1,062	NA	NA
BAHAMAS[2]			
Cement, hydraulic ---- thousand metric tons	381	271	22
Petroleum refinery products:[e]			
Jet fuel ---- thousand 42-gallon barrels	9,647	7,708	9,935
Distillate fuel oil ---- do	11,038	8,928	21,452
Residual fuel oil ---- do	44,645	36,099	53,032
Other ---- do	13,372	10,791	15,989
Refinery fuel and losses ---- do	744	707	888
Total ---- do	79,446	64,233	101,246
Salt ---- thousand metric tons	1,232	1,353	1,670
Stone:			
Aragonite ---- do	1,232	2,069	2,454
Limestone for cement ---- do	521	35	NA
BARBADOS[2]			
Gas, natural:			
Gross production[e] ---- million cubic feet	125	158	197
Marketed production ---- do	120	e152	129
Petroleum:			
Crude ---- thousand 42-gallon barrels	123	110	124
Refinery products:			
Gasoline ---- do	305	311	328
Kerosine ---- do	68	71	62
Distillate fuel oil ---- do	461	378	229
Residual fuel oil ---- do	192	279	518
Other ---- do	30	33	30
Refinery fuel and losses ---- do	123	126	137
Total ---- do	1,179	1,198	1,304
CUBA[2 3]			
Cement, hydraulic ---- thousand metric tons	2,083	e2,000	e3,000
Chromite[e] ---- do	30	30	30
Cobalt[e] ---- metric tons	1,600	1,600	1,600
Copper, mine output, metal content[e] ---- do	3,000	5,000	3,000
Fertilizer, manufactured, nitrogenous[e] ---- thousand metric tons	50	82	187
Iron and steel, crude steel ---- do	240	250	300
Nickel:			
Mine output, content of oxide and sulfide[e] ---- metric tons	36,600	36,800	37,000
Smelter[e 5] ---- do	18,000	18,000	18,000
Petroleum:			
Crude ---- thousand 42-gallon barrels[e]	1,000	775	775
Refinery products:			
Motor gasoline ---- do	r8,049	e8,767	NA
Kerosine ---- do	r3,464	e3,604	NA
Distillate fuel oil ---- do	r8,087	e8,915	NA
Residual fuel oil ---- do	r18,788	e19,381	NA
Lubricating oil ---- do	r e1,057	e1,155	NA
Other:			
Liquefied petroleum gas ---- do	r e962	e1,044	NA
Unspecified ---- do	2,417	e3,034	NA
Total ---- do	r42,824	e45,900	NA
Pyrite, gross weight[e] ---- thousand metric tons	50	50	NA
Sulfur:			
Content of pyrite[e] ---- do	20	20	NA
Byproduct, petroleum[e] ---- do	8	8	NA
DOMINICA			
Stone and sand and gravel:			
Gravel, crushed ---- thousand metric tons	23	NA	NA
Pumice and volcanic ash ---- do	106	NA	NA
Sand ---- do	2	NA	NA

See footnotes at end of table.

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Table 1.—Islands of the Caribbean: Production of mineral commodities —Continued

Area, commodity, and unit of measure[1]	1975	1976	1977[p]
DOMINICAN REPUBLIC[2]			
Aluminum, bauxite, dry equivalent, gross weight[e] thousand metric tons	754	517	643
Cement, hydraulic do	578	531	872
Gold thousand troy ounces	195	414	348
Gypsum:			
For cement thousand metric tons	[e]147	[e]127	167
Other do	NA	NA	2
Lime metric tons	[e]2,150	[e]1,980	179,308
Nickel:			
Mine output, metal content do	26,900	24,400	24,200
Smelter (nickel content of ferronickel shipments) do	30,000	24,400	24,500
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	2,734	2,728	2,738
Kerosine and jet fuel do	396	375	353
Distillate fuel oil do	2,673	2,523	2,665
Residual fuel oil do	2,444	4,368	2,643
Other do	545	1,691	613
Refinery fuel and losses do	366	489	423
Total do	9,158	12,174	9,435
Salt metric tons	[e]40,000	[r e]20,000	16,157
Silver, metal thousand troy ounces	109	907	1,357
Stone and sand and gravel:			
Limestone[e] thousand metric tons	148	217	179
Sand and gravel[e] metric tons	80	--	NA
GUADELOUPE			
Abrasives, natural, pumice thousand metric tons	200	NA	NA
Stone and sand and gravel:			
Stone, crushed or broken do	411	NA	NA
Limestone do	702	NA	NA
Sand do	165	NA	NA
HAITI[2]			
Aluminum, bauxite, dried, gross weight do	522	660	588
Cement, hydraulic do	150	245	266
Clays do	NA	64	67
Gypsum for cement metric tons	NA	NA	10,353
Stone and sand and gravel:			
Limestone, crushed do	[r]191	262	338
Sand and gravel[e] cubic meters	20,000	NA	NA
JAMAICA			
Aluminum:			
Bauxite, dry equivalent of crude ore, gross weight thousand metric tons	11,571	10,306	11,465
Alumina do	2,375	1,621	2,052
Cement, hydraulic do	407	365	333
Clays for cement do	[e]140	132	160
Fertilizers, manufactured, mixed do	22	19	15
Gypsum do	240	253	215
Lime do	183	[e]244	186
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	1,247	1,189	1,879
Kerosine do	401	482	349
Jet fuel do	587	481	480
Distillate fuel oil do	2,136	1,831	1,858
Residual fuel oil do	4,990	3,789	2,391
Other:			
Liquefied petroleum gas do	234	281	255
Unspecified do	310	212	140
Refinery fuel and losses do	284	243	1,504
Total do	10,189	8,508	8,656
Sand and gravel:			
Glass sand thousand metric tons	33	26	17
Common sand and gravel do	3,008	3,479	812
Stone:			
Limestone do	2,540	868	717
Other do	7,620	1	[e]914
MARTINIQUE			
Clays thousand cubic meters	27	[e]27	NA
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	1,920	NA	NA
Kerosine do	(e)	NA	NA

See footnotes at end of table.

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Table 1.—Islands of the Caribbean: Production of mineral commodities —Continued

Area, commodity, and unit of measure[1]	1975	1976	1977[p]
MARTINIQUE —Continued			
Petroleum refinery products —Continued			
Jet fuel thousand 42-gallon barrels	--	NA	NA
Distillate fuel oil do	635	NA	NA
Residual fuel oil do	940	NA	NA
Other, liquefied petroleum gas do	178	NA	NA
Total do	3,673	NA	NA
Pumice thousand metric tons	r78	e80	e80
Salt[e] do	163	163	150
Stone and sand and gravel:			
Stone, crushed and broken thousand cubic meters	311	e300	e300
Sand do	255	e250	e250
MONTSERRAT			
Sand and gravel, natural cubic meters	13,915	5,402	3,161
Other quarry products[r] do	NA	8,103	3,393
NETHERLANDS ANTILLES[2]			
Fertilizer materials:			
Phosphatic, crude, phosphate rock thousand metric tons	82	54	79
Nitrogenous, manufactured (sales)[e 4] do	21	6	3
Petroleum refinery products:			
Gasoline:			
Aviation thousand 42-gallon barrels	1,643	1,276	1,202
Motor do	10,038	15,120	17,223
Jet fuel do	14,427	16,316	12,908
Kerosine do	794	5,906	353
Distillate fuel oil do	23,287	21,635	24,660
Residual fuel oil do	128,553	119,283	100,265
Lubricants do	2,373	4,221	3,355
Other do	27,267	28,948	25,280
Refinery fuel and losses do	12,846	13,264	12,264
Total do	221,228	225,969	197,510
Salt[e] thousand metric tons	480	480	400
Sulfur, byproduct of petroleum do	87	95	NA
ST. VINCENT			
Salt do	50	50	50
Sand and gravel, natural thousand cubic meters	(e)	413	413
Other quarry products do	(e)	764	764
TRINIDAD AND TOBAGO			
Asphalt, natural thousand metric tons	73	66	e60
Cement, hydraulic do	255	242	216
Clays:			
Argillite thousand cubic meters	198	68	121
Other do	74	(11)	89
Fertilizer materials, manufactured, nitrogenous thousand metric tons	333	338	329
Gas, natural:			
Gross production million cubic feet	126,490	137,959	NA
Marketed production do	62,990	78,559	NA
Gypsum metric tons	NA	NA	9,787
Natural gas liquids thousand 42-gallon barrels	61	53	e50
Petroleum:			
Crude do	78,613	77,673	83,950
Refinery products:			
Gasoline:			
Aviation thousand 42-gallon barrels	189	319	361
Other do	13,958	10,187	18,355
Jet fuel do	3,870	4,281	2,462
Kerosine do	3,953	6,864	5,802
Distillate fuel oil do	10,827	12,161	10,705
Residual fuel oil do	48,377	67,797	56,296
Lubricants do	517	824	926
Other:			
Liquefied petroleum gas do	332	404	465
Asphalt do	151	130	201
Unspecified do	684	11,331	3,415
Refinery fuel and losses do	2,802	3,297	3,010
Total do	85,660	117,595	99,536
Sand and gravel:			
Pitch sand thousand cubic meters	33	207	46
Other sand and gravel do	346	360	642
Stone:			
Diorite do	(11)	1	1,153

See footnotes at end of table.

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Table 1.—Islands of the Caribbean: Production of mineral commodities —Continued

Area, commodity, and unit of measure[1]	1975	1976	1977[p]
TRINIDAD AND TOBAGO —Continued			
Stone —Continued			
Limestone:			
For cement ---------- thousand metric tons	425	395	323
Other ---------- thousand cubic meters	NA	NA	445
Porcellanite ---------- do	13	27	e27
Sulfur, byproduct of petroleum[12] ---------- thousand metric tons	49	55	30

eEstimate. pPreliminary. rRevised. NA Not available.

[1]In addition to the countries listed individually in this table, Bermuda, Grenada, and St. Lucia presumably produced crude construction materials (clays, sand and gravel, and stone) but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2]In addition to the commodities listed, mineral commodity output may also include crude construction materials (sand and gravel, lime, and salt) other than those listed, but data on such production are not collected and available information is inadequate to make reliable estimates of output levels.

[3]In addition, gypsum, iron ore, manganese ore, pyrite, and salt, all produced in significant quantities prior to the termination of publication of official statistics, presumably were produced during the period covered by the table, but information is inadequate to formulate reliable estimates of output.

[4]Period is for year ending June 30 of that stated.

[5]Includes nickel content of nickel oxide and nickel fonte in addition to metallic nickel and ferronickel.

[6]Export figure, all production presumed to be exported.

[7]Includes crushed volcanic rock, limestone, diorite, or quartzite used for building stone, aggregate, road construction, etc.

[8]Figure included in gasoline.

[9]Reported figure is 12,700 metric tons.

[10]Reported figure is 5,690 metric tons.

[11]Less than 1/2 unit.

[12]In addition, may produce limited quantities of byproduct sulfur from natural gas.

quarry and other construction-oriented materials produced mostly for local consumption.

General Crude Oil Co. drilled six wells for a total of 37,200 feet during 1977. Of these developmental wells, five produced oil and one produced natural gas. Total average daily crude oil production during 1977 was about 500 barrels, an increase over the average of 400 barrels per day produced during 1976.

The Governments of Barbados and Guyana contracted engineering and project management services from Holderbank Consulting Ltd. for the island's only cement plant. The plant was expected to become operational in 1979 with an annual capacity of 250,000 tons of clinker. The Barbados plant will grind 150,000 tons into cement annually while the remaining 100,000 tons of clinker are destined for shipment to Guyana for grinding. The contract with Holderbank included a provision for additional docking facilities to accomodate the clinker export.

BERMUDA

Small quantities of sand, dimension limestone, and crushed limestone remained the center of mining activity in Bermuda. The local construction industry consumed all the building materials produced.

CUBA

Unlike most other major world nickel producers that suffered throughout 1977 from depressed demand and an oversupplied market, Cuba completed the year unscathed by virtue of its membership in the Council for Mutual Economic Assistance (CMEA).[2] Through CMEA membership, Cuba had fixed-price ($2.72 per pound nickel f.o.b. Cuba), long-term sales contracts. With the security of its own guaranteed market Cuba continued plant expansion plans despite the downward trend in world market conditions. The first expansion phase has been initiated and included modernization of the Pedro Soto Alba plant at Moa Bay and the René Ramos Latour plant at Nicaro. Current capacity of 18,000 tons of nickel per year at each plant will be expanded to permit a combined output of 46,500 tons per year by 1980; by 1985 it is

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anticipated that the combined output will reach 90,000 tons per year. Phases two and three include the construction of additional mine and plant capacity to bring 1990 total nickel production to 180,000 tons per year.

The construction of a 50,000- to 100,000-ton-per-year capacity stainless steel plant was planned for Holguin near Nicaro, with a completion date of 1985. Most of the steel produced would be used in the manufacture of equipment for the sugar refining industry. The 350,000-ton-per-year carbon steel plant at Antillana was under expansion.

Construction continued on the largest Cuban cement plant, Rene Acray, at Mariel. When it comes on-stream in 1978 with an annual output of 700,000 tons of cement, total Cuban production will exceed 3 million tons per year. Expansion set for a late 1979 completion will boost total Rene Acray plant capacity to 1.4 million tons per year. The plant is designed to be computer-controlled and nearly fully automated. It is anticipated that completion of this plant as well as some new, smaller plants will enable Cuba to add cement to its list of export commodities.

Four new oilfields were discovered in the North Cuban Basin from late 1976 through 1977. These fields, the Varadero, Camarioca, Chapelin, and Boca Jaruco, were not expected to offset production declines from the older fields in central Cuba, notably Jatibonico, discovered in 1954, and Cristales, discovered in 1956. Of the new fields, Varadero was thought to be the largest in the Basin. Production data from the new fields were not available. Total Cuban production was variously estimated at 1,000 to less than 3,000 barrels of crude oil per day.

Imports of oil from the U.S.S.R. continued to supply the bulk of Cuba's domestic needs. These imports during 1977 were reported as over 160,000 barrels per day. Oil refining capacity was estimated at 120,000 barrels per day. Six to eight heavy land rigs were reported working in 1977, but only one seismic crew and a few geological field parties were known to have been actively engaged in exploration activity.

To alleviate some of the domestic need for fuel oil and ease the foreign trade deficit, Cuba's current 5-year plan (1976-80) included the construction of a nuclear electric power station with a rating of 880,000 kilowatts.

Table 2.—Cuba: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Chromium ore and concentrate	25,021	15,346	Poland 4,967; West Germany 4,959; Spain 4,000; Austria 1,420.
Copper:			
Ore and concentrate, excluding matte	11,350	4,000	All to West Germany.
Scrap	--	254	United Kingdom 126; Netherlands 46; West Germany 32.
Nickel metal, unwrought including alloys	1,321	2,850	Italy 943; West Germany 749; Austria 570.
Silver and platinum ores, waste, etc. value	--	$268,000	All to United Kingdom.
Zinc ore and concentrate	--	851	All to Yugoslavia.
Nonferrous metal scrap, n.e.s	--	96	All to West Germany.
Ore and concentrate, n.e.s.[1] value, thousands	$56,369	$70,495	All to U.S.S.R.
NONMETALS			
Diamonds:			
Non-industrial, unset value	$787,000	$518,000	Belgium-Luxembourg 435,000; Canada 83,000.
Other, n.e.s do	$11,000	--	
Inorganic elements, oxides, etc	1,748	2,965	Italy 2,824; Netherlands 118; Yugoslavia 23.
MINERAL FUELS AND RELATED MATERIALS			
Petroleum products:			
Gasoline, motor spirit	20,013	14,541	All to Netherlands.
Nonlubricating oils	10,037	33,721	All to West Germany.

[1]Believed to be principally nickel-bearing material.

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Table 3.—Cuba: Imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Oxide and hydroxide	89	91	All from Japan.
Metal including alloys:[3]			
Unwrought	1,000	2,675	Hungary 2,177; Canada 413.
Semimanufactures	9,393	[2]5,177	Hungary 1,761; Spain 1,542; Belgium-Luxembourg 970.
Arsenic acids	62	55	All from France.
Copper metal including alloys:[3]			
Scrap	--	270	All from United Kingdom.
Semimanufactures	6,640	1,703	Japan 891; Canada 428; Spain 227.
Iron and steel metal:			
Scrap thousand tons	55	78	All from U.S.S.R.
Pig iron do	146	218	Mainly from U.S.S.R.
Ferroalloys	7,347	6,721	U.S.S.R. 5,846; Japan 875.
Semimanufactures:			
Bars, rods, angles, shapes thousand tons	159	44	Spain 8; Hungary 8; West Germany 6; Bulgaria 6.
Plates and sheets do	202	79	U.S.S.R. 41; Spain 14; Japan 11.
Hoop and strip do	2	4	Japan 2; France 2.
Rails and accessories do	17	21	Italy 19.
Wire do	47	30	U.S.S.R. 29.
Tubes, pipes, fittings do	112	84	U.S.S.R. 47; France 25; Japan 5.
Castings and forgings do	5	1	Mostly from France.
Unspecified do	44	250	U.S.S.R. 236; Czechoslovakia 14.
Total do	588	513	
Lead metal including alloys:[3]			
Unwrought	1,156	1,307	All from Japan.
Semimanufactures	354	301	All from Belgium-Luxembourg.
Manganese oxides	79	327	All from Japan.
Nickel metal including alloys, semimanufactures	21	7	Sweden 4; West Germany 3.
Platinum-group metals including alloys, all forms value, thousands	$18	$29	All from United Kingdom.
Silver metal including alloys, all forms do	$385	$138	Canada $85; Japan $42.
Tin metal including alloys, unwrought	101	115	Spain 100; Netherlands 15.
Zinc oxide and peroxide[3]	755	328	All from Japan.
Other:			
Oxides, hydroxides and peroxides of metals, n.e.s	11	27	West Germany 17; Japan 10.
Nonferrous metals including alloys:[3]			
Unwrought	3,020	4,107	All from U.S.S.R.
Semimanufactures	11,729	15,792	Do.
NONMETALS			
Abrasives, grinding wheels and stones	99	216	Spain 145; France 36; West Germany 35.
Cement thousand tons	[2]91	155	U.S.S.R. 145; Japan 10.
Clay and clay products:			
Crude clay, n.e.s	521	700	All from Spain.
Refractory products	35,459	26,739	U.S.S.R. 18,242; Spain 4,216.
Diatomite and other infusorial earths	196	401	All from Italy.
Feldspar and fluorspar	224	200	All from Spain.
Fertilizer materials, manufactured:			
Nitrogenous thousand tons	312	472	Mainly from U.S.S.R.
Phosphatic do	144	210	U.S.S.R. 185; Spain 20; Portugal 5.
Potassic do	166	170	U.S.S.R. 150; West Germany 5; Belgium-Luxembourg 5.
Ammonia	13,211	13,613	All from U.S.S.R.
Magnesite	--	1,600	All from Spain.
Pigment, iron oxide	813	188	All from West Germany.
Precious and semiprecious stones value, thousands	$37	$30	All from Switzerland.
Sodium and potassium compounds:			
Caustic soda	45,770	26,560	U.S.S.R. 25,560.
Caustic potash	--	77	All from Japan.
Soda ash	15,480	21,449	Bulgaria 11,420; U.S.S.R. 10,029.
Sulfur, elemental	141,407	30,141	All from Canada.
Other:			
Slag and ash value, thousands	$58	$31	Do.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	3,837	4,048	U.S.S.R. 3,849; West Germany 199.
Petroleum, refinery products:			
Distillate fuel oils thousand 42-gallon barrels	--	2	All from West Germany.
Lubricants do	138	14	Portugal 6; United Kingdom 3.

See footnotes at end of table.

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Table 3.—Cuba: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum, refinery products —Continued			
Other:			
Mineral jelly and wax ----------do----	2	1	All from Netherlands.
Nonlubricating oils ----------do----	2	2	All from United Kingdom.
Unspecified ----------do----	146	101	All from U.S.S.R.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals ----------	711	427	All from United Kingdom.

[1]Data are compiled from 1976 edition of the United Nations Supplement to the World Trade Annual, v. II, as well as official trade statistics of Bulgaria, Czechoslovakia, Hungary, Poland, and U.S.S.R.
[2]Data incomplete, tonnage not available for all sources.
[3]Individual commodity totals for 1976 and data on distribution by trading partners exclude figures for U.S.S.R., which are not divided by individual metals, but rather are reported in two categories listed at the end of the metals section as "Nonferrous metals including alloys: Unwrought and semimanufactures."

DOMINICAN REPUBLIC

Total exports from the Dominican Republic rose to about $780 million for 1977, of which at least 25% was attributable to minerals. Exports of gold, silver, nickel, and bauxite, the principal mineral products, remained at about the same level as in 1976 but declines in the prices of agricultural exports served to emphasize the impact of minerals on the economic sector.

In 1976 the Government began studies directed towards the establishment of a new law to regulate the mining industry. In 1977 the Government sponsored a symposium to draft new mining legislation but formal Senate acceptance of recommendations did not materialize. Meanwhile, the 1976 participation agreement with Rosario Dominicana S.A., and the 1977 agreement with the Aluminum Company of America (Alcoa) that effectively tied bauxite royalty payments to the computed average price of aluminum, appeared to be indicators of the still-developing Government policy. Exploration licenses for metallic minerals were granted only through specific contract negotiation with the Executive Power.

Increased gold and silver values offset rising production costs for Rosario's Pueblo Viejo mining, milling and cyanide complex located about 50 miles northwest of Santo Domingo. The complex is a joint venture of Rosario Resources (27%), Simplot Industries (27%) and the Dominican Republic (46%), and includes the largest open pit gold mine in the world. The mill treated 2.6 million dry tons of ore in 1977, approximately the same as the previous year, but 1977 gold recovery was 348,473 troy ounces, a decrease of 16% from that of 1976, and silver recovery was 1,357,290 troy ounces, an increase of 50% over 1976 production. These differences reflect variations in the metal distribution within the ore body. Reserves consist of an estimated 23 million tons of oxide ores amenable to cyanide treatment with an average assay of 0.117 ounce of gold per ton and 0.69 ounce of silver per ton. A new jaw crusher was installed and work was underway on a new grinding mill to increase daily throughput capacity from 8,000 to 9,000 tons. Rosario produces 75-pound bricks of dore bullion averaging about 20% gold and 80% silver which are assayed, stamped, numbered, and shipped to Switzerland.

In 1976 small beads of mercury were found in the exhaust fan at the Pueblo Viejo cyanide plant. Subsequent investigations revealed that ore precipitate contained 8% to 10% mercury and its removal from the bullion was essential to prevent contamination. The actual mercury mineral or minerals present in the ore have not been identified but all or most of it is believed to be taken into solution as the milled ore passes through the plant circuit since the quantity of mercury produced is compatible with the mercury analysis of the ore. An extension to the plant was constructed to house the 12 retorts installed for mercury recovery and following initial startup in March a total of 515 flasks were recovered during 1977 although no shipments were made from the plant. The recovery was not expected to be a profitable operation due to the current market price of mercury but its removal reduces the impurities, moisture content, and bulk of the precipitate, consequently lessening the need for fluxing reagents and melting furnace operating time during the sub-

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sequent production of dore.

Falconbridge Dominica C. por A. (FALCONDO), the fourth-ranking nickel producer within the market economy countries, did not escape the effects of diminished market demand. Production levels were maintained until about midyear, but by November, plant output had been reduced to one-third of capacity and the work force was cut from 2,150 to 1,600 employees. Yearend figures did not reflect the severe reductions as about 71,000 tons of ferronickel were produced in 1977. Contained nickel amounted to about 24,200 tons compared with 24,400 tons in 1976. Contained nickel exports, however, were 20,000 tons during 1977, a decrease of 5,000 tons from 1976 shipments.

Alcoa signed a new one-year bauxite agreement that provided for an extraction tax as determined by Alcoa's average sale price of aluminum. Alcoa's bauxite deposits are located in the Bahoruco Mountains of Pedernales Province in the southwestern part of the Dominican Republic. Ore is moved by truck along one of the world's longest hauling roads (24 miles) to Cabo Rojo where it is solar dried and exported to the United States. Production rose slightly during 1977, to 642,667 tons but remained about half of that produced in 1974, a reflection of both poor world market conditions and Alcoa's shift to bauxite production in Guinea, West Africa.

The prospects of finding substantial reserves of oil in the Dominican Republic prompted several companies to negotiate exploration concessions during 1977. Petrolera Las Mercedes S.A., a private Venezuelan firm, received the Azua, Bani Llamura Oriental zones and the offshore southeast coastal area from Catalina Island to Palenque. Magnetic, gravity, and seismic work were completed during 1977 and drilling is targeted to start in 1978. An exploration permit was granted to Eastern Petroleum Co., a Houston-based U.S. company, in association with Canadian Superior Ltd. of Calgary, Alberta, for a 735,000-acre tract covering the Lago Enriquillo Basin area in the southwestern part of the country near the Haitian border. Canadian Superior is an affiliate of the Superior Oil Co. of Houston, Tex., a principal owner of FALCONDO.

Quisqueya Oil, a private Dominican firm, will explore the Cibao Valley. Quisqueya's production sharing contract covers 6,562 square miles of onshore and offshore areas in northern and northwestern Dominican Republic. The contract called for an expenditure of $5 to $6 million during the four-year exploration period. A private U.S. firm, Cariboil, will explore the onshore Cenca de San Juan block. Its concession area covers 1,560 square miles in the west-central part of the country. Corporación Dominicana de Electricidad (CDE) began a testing program on old wells in the Maleno field, currently held by Las Mercedes. CDE asked the Government for a concession to include a 3-mile radius area around each well.

HAITI

Bauxite remained the principal mineral resource contributing to the Haitian economy and continued to rank second in total foreign exchange earnings. In January, Reynolds Haitian Mines Inc., a subsidiary of Reynolds Metals Co. (United States), reached a new 5-year agreement with the Government. The agreement included a new tax computation formula which provided that the proportional tax be based on the tonnage of bauxite exported. The severance tax computation contained a provision for a tax rate of 7.5% of the average realized price of primary aluminum. The new contract agreement may be extended for an additional five years.

Offshore oil exploration had an unfortunate beginning as Crux International Ltd., a subsidiary of Southern Cross Petroleum Co., drilled three dry holes in its 1.5-million-acre concession located about 13 miles northwest of Port-au-Prince in water averaging 300 feet in depth. Crux did not plan to continue drilling until it completed an evaluation of the collected data. A Venezuelan firm, Hideca de Venezuela, was the only other company with petroleum rights in Haiti. Hideca continued conducting gravity surveys in the Plateau Centrale.

The joint venture between the Government and the Société Minière d'Haiti, S.A., a subsidiary of Kennecott Copper Corp., continued its exploration for sulfide deposits in northern Haiti. The discovery of a sizable copper deposit was reported but details were not available. The Société Franco-Hatienne de Mines S.A., a subsidiary of Penarroya of France, and the Hai-

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tian Government continued their joint sulfide exploration activities in northern Haiti, drilling on several copper prospects. The agreements with both Kennecott and Penarroya provided that Haiti will hold a 40% interest in each developed prospect.

The Institut Nacional de Resources Minérales (INAREM), formed by the Government in 1976 to participate in the exploration and development of resources, and the United Nations Development Program (UNDP) continued their joint mineral deposit survey of northern Haiti and expanded their investigations to include the southern half of the country. Earlier work by the UNDP in northern Haiti identified 14 copper deposits, mostly porphyry. One of these porphyry deposits, in the Terrier Range near Fort Liberté, was reported to contain 150 to 200 million tons of reserves grading 0.6% copper and is now under study by both the Geological Survey of Hanover, Federal Republic of Germany, and Metallgesellschaft as part of a German foreign aid program. Definitive exploratory drilling is projected, with three deep holes planned for 1978.

Table 4.—Haiti: Exports and imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations and sources, 1976
EXPORTS			
Aluminum bauxite	522,707	738,758	All to United States.
Cement	1,633	70,849	Dominican Republic 32,844.
Iron and steel, scrap	74	96	United States 67; West Germany 29.
IMPORTS			
METALS			
Aluminum metal, all forms	328	212	United States 108; Austria 58.
Copper metal, all forms	20	34	United States 14; Japan 12.
Iron and steel:			
Ore and concentrate	23	119	All from United States.
Scrap	5	30	Mainly from United States.
Semimanufactures[2]	14,660	14,978	Japan 4,825; United States 4,122; West Germany 2,967.
Lead metal, all forms	31	3	Mainly from United States.
Platinum group metals and silver:			
Ore and concentrate, kilograms	68	NA	
Metals including alloys:			
Platinum-group metals, troy ounces	64	129	All from United States.
Silver, do	129	2,508	Do.
Tin metal, all forms	333	1	Mainly from United States.
Other:			
Ore and concentrate, n.e.s	2	7	United States 4; Puerto Rico 2.
Base metals including alloys, all forms	(3)	1	All from United States.
NONMETALS			
Abrasives, natural, grinding and polishing wheels and stones	5	12	United States 10.
Asbestos, crude	1	1	All from United States.
Cement	924	1,066	Belgium-Luxembourg 446; Denmark 367.
Clays:			
Crude	104	97	United States 59; Mexico 37.
Manufactured products	989	821	United States 349.
Feldspar, fluorspar, cryolite, chiolite	(3)	NA	
Fertilizer materials:			
Crude:			
Phosphatic	8	6	Mainly from Ecuador.
Potassic	36	19	All from United States.
Manufactured, nitrogenous	168	15	Do.
Mica worked and unworked, including splittings and waste	11	9	All from United States.
Pigments, mineral, natural	164	139	United States 89; Poland 16.
Salt	140	468	Jamaica 240; United States 228.
Stone and sand and gravel:			
Sand and gravel, including crushed quartz	334	114	Netherlands 78; United States 30.
Stone:			
Dimension worked and partly worked	31	142	Italy 99; United States 43.
Industrial, except dimension	1,644	2,258	Mainly from Dominican Republic.
Limestone	(3)	4	Mainly from United States.
Sulfur, elemental	15	NA	

See footnotes at end of table.

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Table 4.—Haiti: Exports and imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations and sources, 1976
NONMETALS —Continued			
Other:			
Building materials of asphalt and asbestos and fiber cement and unfired nonmetals, n.e.s	208	273	United States 148; Dominican Republic 57.
Nonmetallic minerals worked and unworked, n.e.s	(3)	3	Mainly from United States.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt, natural	905	3,204	Jamaica 1,545; United States 1,109.
Coke, coke agglomerates	14	20	Belgium-Luxembourg 10; Colombia 10.
Petroleum refinery products:			
Gasoline, thousand 42-gallon barrels	82	90	Mainly from Netherland Antilles.
Kerosine, do.	5	8	Do.
Distillate fuel oil, do.	572	774	Do.
Lubricants, do.	22	14	United States 5.
Other:			
Liquefied petroleum gas, do.	18	22	Canal Zone 11.
Mineral waxes, do.	1	1	Mainly from United States.
Bituminous mixtures, n.e.s, do.	1	14	Jamaica 8; United States 5.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	14	8	United States 4; United Kingdom 4.

[1]Data are for years ending September 30 of that stated.
[2]Includes small quantities of pig iron, ferroalloys, and crude steel.
[3]Less than 1/2 unit.

JAMAICA

Bauxite remained Jamaica's major mineral resource during 1977 as bauxite-alumina production accounted for two-thirds of the country's export earnings and 16.5% of the gross domestic product (GDP). Revenues derived from the bauxite-alumina industry amounted to $190 million in 1977, a 30% increase over that of 1976. Despite this gradual improvement in bauxite earnings, Jamaica remained confronted with serious economic problems and further tightening of import restrictions, reduced government spending, and other stringent controls were projected. Although the Government offers assurance that it encourages foreign investment, especially with government participation, there is an increasing problem in retaining foreign capital as well as skilled labor in the country. Furthermore, since the introduction of the increased bauxite levy in 1974, there has been no expansion of the bauxite and alumina industry.

In February, the Kaiser Aluminum & Chemical Corp. and the Government of Jamaica finalized a partnership agreement in which the Government purchased a 51% interest in Kaiser Bauxite Co.'s mining operation. Kaiser sold all of its bauxite land, resettlement lands and other property not required for plant operation to the Government. The new partnership, Kaiser Jamaica Bauxite Co., received a 40-year mining lease for sufficient bauxite to supply two Kaiser alumina plants in Louisiana at their current rate of production. The agreement provides that Kaiser may purchase bauxite from the partnership at cost and will pay the Government a return on its investment in the partnership. In return for the mining rights Kaiser will pay the Government annually an amount equal to 7% of the Government's purchase price for the land under the mining lease. The new company received a reduced bauxite levy of 7.5% with a further reduction to 7% after production passes a certain level.

Reynolds Jamaica Mines Ltd., a subsidiary of Reynolds Metals Co., also finalized an agreement with the Government that provided for the State to purchase a 51% interest in Reynold's mining operations. As in the Kaiser agreement, Jamaica purchased Reynold's mining and agricultural lands at book value while guaranteeing the new company, Jamaica Reynolds Bauxite Partners, mining leases for bauxite reserves sufficient for 40 years at the current rate of production. An agreement for government participation in Alcan Jamaica Ltd.'s mining and refining operations was expected to be completed in 1978. The Alumina Partners of Jamaica (ALPART) bauxite-alumina operation, owned through its Jamaican subsidiaries by Kaiser Aluminum & Chemical Corp. (36.5%), Reynolds Metals Co. (36.5%)

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and The Anaconda Company (27%) is expected to enter into a similar agreement in the near future.

The Overseas Private Investment Corporation (OPIC), a U.S. Government insurance agency, rejected the application for expropriation compensation filed by Revere Jamaica Alumina Ltd. Revere's Jamaican bauxite and alumina operations were suspended in August 1975 because, according to Revere, of the weak demand for aluminum and partially owing to the economic effect of a substantial increase in the bauxite production levy Jamaica imposed on the company in 1974. Revere contended that the amount of excess levy, over and above that provided for in its 1967 investment agreement, for the years 1974 and 1975 came to over one-sixth of its stockholders' equity at the end of 1973. Revere claimed that the increased levy was tantamount to expropriation. Meanwhile, Revere did obtain a minor victory when the Jamaican Supreme Court ruled that although the increased production levy was valid, it could not be applied in any full year when the company's facilities were not in production. The Government had required that Revere continue paying the levy as if it were producing bauxite at the rate of 445,000 tons per year. Revere's appeal against the OPIC decision was pending before the American Arbitration Association. Revere has also undertaken legal actions to avoid losing its mining lease due to the extended shutdown. The Jamaican mining law stipulates that any lease in a nonproducing status for more than 6 months automatically expires unless special consent is secured from the Ministry of Mines. The Government has not taken any action to cancel the mining lease, but neither have they granted an exception to the law based on Revere's contention that the shutdown was due to the depressed state of the world's aluminum industry. The Jamaican Supreme Court refused to rule on Revere's request for an extended cessation of production.

Jalumex, the bauxite-alumina-aluminum processing complex proposed as a joint partnership between the Governments of Jamaica and Mexico had not received final official approval by both parties at the end of 1977. Construction, originally expected to be initiated in 1977, was delayed pending finalization of the agreement.

The projected 80,000-barrel-per-day oil refinery to be constructed at Luana Point, St. Elizabeth, has been postponed indefinately and at least some employees of the Petroleum Co. of Jamaica (PETROJAM) were being assigned to other Government activities. The refinery was to be part of a large petrochemical complex which included a

Table 5.—Jamaica: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Bauxite and concentrate ____ thousand tons	5,483	6,284	All to United States.
Alumina ____ do	r2,375	1,621	United States 491; Norway 435; United Kingdom 262; Sweden 152.
Metal, including alloys:			
Scrap	668	715	United States 659.
Unwrought and semimanufactures	444	612	Trinidad and Tobago 306; Martinique 128; Guadeloupe 87.
Copper:			
Copper sulfate	1	--	
Metal including alloys:			
Scrap	125	276	West Germany 188; Italy 61; United Kingdom 27.
Unwrought and semimanufactures	23	40	All to United Kingdom.
Iron and steel metal:			
Scrap	181	104	All to United States.
Steel, primary forms	97		
Semimanufactures[1]	1,196	6,481	Trinidad and Tobago 4,907.
Lead metal including alloys:			
Scrap	(2)	182	Mainly to Denmark.
Unwrought and semimanufactures	4	2	All to United States.
Nickel metal and alloys, unwrought and semimanufactures	--	1	Do.
Platinum-group metals and alloys, unwrought and semimanufactures ____ value, thousands	$3	--	
Tin metal including alloys:			
Scrap	1,700	923	United States 911.

See footnotes at end of table.

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Table 5.—Jamaica: Exports and reexports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Tin metal including alloys —Continued			
Unwrought and semimanufactures	35	469	United States 441.
Zinc metal and alloys, unwrought and semimanufactures	414	2	Mainly to Belize.
Other:			
Ash and residues containing nonferrous metals	42	(e)	
Scrap of nonferrous metal, n.e.s	65	80	United States 33; United Kingdom 30; Spain 17.
NONMETALS			
Abrasives	(2)	(2)	All to West Germany.
Cement, hydraulic	(2)	--	
Chalk	--	14	Guyana 13; Antigua 1.
Clays and clay products:			
Crude	54	10	Italy 8; Trinidad and Tobago 2.
Products:[4]			
Nonrefractory	--	1	Mainly to Barbados and Dominican Republic.
Refractory value	$2,421	$1,124	United States $1,025; Cayman Islands $99.
Fertilizer materials:			
Manufactured:			
Nitrogenous	5	3	All to Cayman Islands.
Potassic	--	1	Do.
Mixed	2	--	
Ammonia	(2)	--	
Gypsum and plasters	248,366	215,514	All to United States.
Lime	1,712	593	Guyana 246; Barbados 192.
Mica, crude and manufactured	46	8	United States 7; Haiti 1.
Salt	8,440	4,852	Trinidad and Tobago 3,528; Guyana 771.
Stone, sand and gravel:			
Dimension stone, crude and worked	2	--	
Gravel and crushed stone	10	9	Mainly to Grenada.
Sand, excluding metal bearing value	--	$1,714	Guyana $1,595.
Sodium compounds, n.e.s.: Caustic soda	5	1,577	All to Guyana.
Sulfur: sulfuric acid	1,838	196	Trinidad and Tobago 94; Guyana 81.
Talc	6	--	
Other nonmetals, n.e.s.:			
Crude	--	(2)	All to United States.
Slag, dross and similar waste, not metal bearing	15	--	
Building materials of asphalt, asbestos and fiber, cement and unfired nonmetals, n.e.s	283	1	All to Barbados.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	1,565	--	
Hydrogen, helium, rare gases	31	41	Trinidad and Tobago 21; Haiti 5; Dominica 4.
Petroleum:			
Crude oil thousand 42-gallon barrels	--	(2)	All to United States.
Refinery products:			
Gasoline do	19	27	Haiti 15; Cayman Islands 11.
Jet fuel and kerosine do	--	77	NA.
Distillate fuel oil do	147	364	Bahamas 70; Panama 69; Belize 49; Cayman Islands 36.
Residual fuel oil do	195	287	United States 238; West Germany 21.
Lubricants do	151	287	Dominican Republic 52; Nicaragua 37; Panama 29; Guyana 28.
Other:			
Liquefied petroleum gas do	(2)	--	
Nonlubricating oils, n.e.s.:	(e)	(e)	Mainly to Surinam, Trinidad and Tobago, and Haiti.
Pitch and asphalt	29	35	Haiti 22; St. Vincent 7; Cayman Islands 4.
Bitumen	20	2	Haiti 1; Belize 1.
Total	r561	1,079	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	--	12	All to Haiti.

rRevised. NA Not available.
[1]Partial totals; excludes exports valued at r$3,682 in 1975 and $1,236 in 1976.
[2]Less than 1/2 unit.
[3]Value only reported at $8,162.
[4]Partial totals; excludes exports valued at $826 in 1975 and $1,124 in 1976.

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Table 6.—Jamaica: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum:		
Oxide and hydroxide	6	10
Metal and alloys, unwrought and semimanufactures	3,072	4,251
Copper:		
Copper metal and alloys, unwrought and semimanufactures	853	757
Copper sulfate	2	1
Gold metal, unworked or partly worked value, thousands	$45	$676
Iron and steel:		
Metal:		
Scrap	6	108
Pig iron, ferroalloys and similar materials	553	452
Steel, primary forms	22,861	7,974
Semimanufactures	57,771	60,861
Lead metal and alloys, unwrought and semimanufactures	278	84
Magnesium metal and alloys, semimanufactures	(1)	3
Manganese ore and concentrate	164	89,817
Nickel metal and alloys, unwrought and semimanufactures	474	461
Platinum-group metals and silver:		
Ore and concentrate value	--	$210
Waste and sweeping do	$119	--
Metals including alloys:		
Platinum group do	$3,692	$959
Silver do	$692,695	$423,684
Tin metal and alloys, unwrought and semimanufactures	r5,624	8,006
Tungsten metal and alloys, unwrought and semimanufactures	(1)	2
Uranium and thorium metals, unwrought and semimanufactures	3	--
Zinc:		
Metal including alloys:		
Blue powder	28	14
Unwrought and semimanufactures	1,211	783
Other:		
Ore and concentrate, n.e.s	17	63
Scrap of nonferrous metals, not further specified	2	115
Nonferrous metals, n.e.s., unwrought and semimanufactures	8	7
NONMETALS		
Abrasives, natural:		
Pumice, emery, natural corundum, etc	10	5
Dust and powder of precious and semiprecious stones value	$902	--
Grinding and polishing wheels and stone	190	35
Asbestos, crude, washed or ground	1,307	32
Barite, natural	(1)	43
Boron, crude natural	(1)	1
Cement, hydraulic	11,144	1,377
Chalk	6	(1)
Clay and clay products:		
Crude	761	31
Products:		
Nonrefractory	5,580	3,966
Refractory[2]	6,779	4,902
Diamond:		
Gem, not set or strung value, thousands	$90	$83
Industrial do	$5	(1)
Diatomite and other infusorial earths	102	(1)
Feldspar, fluorspar, cryolite, chiolite, nepheline syenite	171	101
Fertilizer materials:		
Crude:		
Phosphatic	2,561	610
Manufactured:		
Nitrogenous	29,993	31,677
Phosphatic	4,437	2,890
Potassic	21,529	15,076
Mixed	4,857	35
Ammonia	70	137
Graphite, natural	2	(1)
Gypsum and plasters	82	140
Lime	239	9
Magnesite, crude	--	2
Mica:		
Crude	165	143
Worked	9	16
Pigments, natural crude	105	16
Precious and semiprecious stones value, thousands	$177	$38
Salt	16,065	1,477
Sodium compounds, n.e.s.:		
Sodium carbonate (soda ash)	7,329	4,657
Sodium hydroxide (caustic soda)	494,182	242,657

See footnotes at end of table.

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Table 6.—Jamaica: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976
NONMETALS —Continued		
Stone, sand and gravel:		
Dimension stone	597	163
Gravel and crushed stone	112	242
Limestone (except dimension)	813	33
Quartz, unground	2	1
Sand, including ground quartz	214	1,191
Sulfur:		
Elemental	4,951	932
Sulfur dioxide	21	5
Sulfuric acid	412	103
Talc, steatite, soapstone, pyrophyllite	1,051	519
Other nonmetals, n.e.s.:		
Crude	18	33
Slag, dross and similar waste, not metal bearing	--	914
Building materials of asphalt, asbestos, fiber cement and unfired nonmetals, n.e.s	833	780
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	379	424
Carbon gas	81,081	23
Coal and briquets	61	67
Coke and semicoke	25,625	1,060
Hydrogen, helium, rare gases	32	54
Peat, including briquets and litter ---- value	$1,267	$1,934
Petroleum:		
Crude and partly refined --- thousand 42-gallon barrels	10,399	8,896
Refinery products:		
Gasoline ---- do	543	743
Jet fuel and kerosine ---- do	158	244
Distillate fuel oil ---- do	490	758
Residual fuel oil ---- do	7,882	6,276
Lubricants ---- do	104	41
Other:		
Liquefied petroleum gas - thousand 42-gallon barrels	155	192
Petroleum jelly and wax ---- do	9	12
Nonlubricating oils, n.e.s ---- do	1	210
Asphalt, bitumen, pitch and pitch coke ---- do	5	6
Petroleum coke ---- do	2	--
Total ---- do	9,349	8,482
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	229	115

'Revised.
'Less than 1/2 unit.
'Partial totals; excludes imports valued at US$1,041,846 in 1975 and US$437,154 in 1976.

caustic soda plant to support the proposed Jalumex alumina plant. The Government reported that PETROJAM offices were not closed.

There was no active petroleum exploration during 1977 although some stratigraphic testing was planned for 1978. The Norwegian Government offered financial and technical assistance for offshore exploration and preliminary surveys were expected to begin in 1978.

MARTINIQUE AND GUADELOUPE

Both Martinique and Guadeloupe are heavily dependent on French Government subsidies and local expenditures to maintain their current levels of economic development. Mineral production in Martinique consisted mainly of pumice, construction aggregates, fertilizers, and cement, all of which was for domestic consumption. The petroleum refinery at Fort de France maintained its output of gasoline and residual and distillate fuel oils.

Guadeloupe's mineral production of domestically consumed construction aggregates did not contribute to export growth.

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NETHERLANDS ANTILLES

Petroleum refining and related activities continued to play an important role in the economy of the Netherlands Antilles during 1977, accounting for 40% of the gross national product and employing 9% of the total work force. Despite the country's appearance of economic prosperity, there were undertones of potential difficulties that can be directly linked to the declining fortunes of the Shell Curaçao N.V. refinery on Curaçao and the Exxon Lago refinery on Aruba. Negative factors pyramiding against the profitable operation of the refineries included the weak international market demand for petroleum products and implementation of the U.S. entitlements program which offered cost advantages to U.S. refineries. Exxon and Shell have had to contend with a drastic loss of their normal U.S. markets plus the increased tendency of other traditional outlets to build their own refineries. The Shell refinery sales to the United States were reported to have dropped 94%, from 265,000 barrels per day in 1973-74 to a mere 16,000 barrels per day in 1977. Market losses required a severe cutback in refinery output which, in turn, created a high unit cost for refined products, which made competition in international trade even more difficult and inhibited efforts to seek additional market outlets. Shell has officially commenced an austerity program to control costs until a more favorable market condition develops.

Marathon Oil Co. drilled its first exploration well off Saba Bank. The well was abandoned at 9,576 feet and Marathon did not plan to drill another test during 1978. A State-owned corporation, Saba Bank Resources, was established by the Government to administer exploration and development activities on the Bank.

Table 7.—Netherlands Antilles: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum metal including alloys, all forms	1	1
Copper metal including alloys, all forms	1	1
Iron and steel:		
Scrap	1,790	7,461
Semimanufactures	133	70
Nickel metal including alloys, all forms	2	46
Silver and platinum-group metal value, thousands	$1	$1
Other: Nonferrous metal including alloys, all forms	1,625	922
NONMETALS		
Cement	63	4,775
Fertilizer materials:		
Crude, phosphatic thousand tons	54	77
Manufactured do	95	103
Salt and brines do	59	131
Stone, sand and gravel	2	--
Sulfur:		
Elemental	70,669	50,740
Sulfuric acid	1,373	--
Other nonmetals, n.e.s	46,376	35
MINERAL FUELS AND RELATED MATERIALS		
Petroleum:[1]		
Crude thousand 42-gallon barrels	7,802	6,463
Refinery products:		
Gasoline:		
Aviation do	1,487	1,069
Other, motor do	8,321	13,686
Jet fuel do	13,560	16,248
Kerosine and white spirit do	744	5,852
Distillate fuel oil do	23,544	20,657
Residual fuel oil do	116,557	109,043
Lubricants do	2,167	3,752
Other do	18,005	8,039
Total do	184,385	178,346
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	--	4,173

ʳRevised.

[1]Source: International Petroleum Annual, (1975, 1976).

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Table 8.—Netherlands Antilles: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum metal including alloys, all forms	r349	408
Copper:		
Sulfate	--	9
Metal including alloys, all forms	357	290
Iron and steel, semimanufactures	27,632	16,874
Lead metal including alloys, all forms	182	81
Nickel metal including alloys, all forms	18	--
Silver metal including alloys, all forms value, thousands	$74	$91
Tin metal including alloys, all forms	29	16
Zinc metal including alloys, all forms	r174	355
Other:		
Nonferrous metal scrap	2	--
Base metals including alloys, n.e.s	10	[1]6
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, industrial diamonds	4	5
Grinding and polishing wheels and stones	159	14
Cement	r85,114	82,075
Clays and clay products (including all refractory brick):		
Crude	814	313
Manufactured	6,215	[2]7,680
Diamond, gem not set or strung carats	1,205	3,880
Fertilizer materials:		
Crude	2	--
Manufactured	656	664
Gypsum and plasters	31	517
Lime	115	774
Mica, worked including agglomerated splittings	--	1
Precious and semiprecious stones, except diamond troy ounces	138	108
Salt	778	749
Sodium and potassium compounds:		
Sodium carbonate	r119	46
Caustic soda	12,522	14,945
Stone and sand and gravel:		
Dimension stone, worked and unworked	r666	820
Crushed rock and sand	r18,536	16,866
Sulfur, sulfuric acid	16,555	2,009
Other crude nonmetals, n.e.s	r2,166	3,372
MINERAL FUELS AND RELATED MATERIALS		
Coal, coke and briquets	15	26
Hydrogen, helium, rare gases	3,472	424
Petroleum:[3]		
Crude oil thousand 42-gallon barrels	211,181	290,049
Refinery products:		
Gasoline, all grades do.	1,334	621
Jet fuel do.	64	256
Distillate fuel oil do.	1,321	1,045
Lubricants do.	35	112
Other do.	1,259	695
Total do.	4,013	2,729
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	15	28

rRevised.
[1]Excludes quantity valued at $5,000.
[2]Excludes quantity valued at $10,556.
[3]Source: International Petroleum Annual, (1975, 1976).

ST. LUCIA

Informal discussions and feasibility studies begun in 1976 culminated this year in the finalization of an agreement between the St. Lucia Government and Amerada-Hess Corp. (United States) to establish an oil refinery and transshipment terminal in the former sugarcane valley of Cul de Sac, near Castries. The agreement is known as the Oil Refinery Act of June 1977. The new company, Hess Oil St. Lucia Ltd., is wholly owned by Amerada Hess. This new refinery complex would be complementary to the Hess operation located at St. Croix, U.S. Virgin Islands.

Construction work on the project site was initiated and the complex is expected to be

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completed in 3 years. The deep water (80 to 90 feet) within 1 mile of shore will accomodate supertankers. Hess received an initial 50-year license and very favorable long-term and wide-ranging exemptions from taxes, customs and other duties, harbor and wharfage dues, and similar costs. The Government will receive 2 cents (US) for every barrel of crude oil and other petroleum products delivered and exported from the terminal and 4 cents (US) for each barrel produced and exported from the refinery. It was estimated that the complex will ultimately employ about 3,000 persons, the majority of whom will be St. Lucians. When completed, the refinery will use Middle Eastern oil and is expected to produce a minimum of 250,000 barrels per day. The agreement with Hess stipulates a penalty for noncompletion of the project. The Government visualized the project site to be part of a "free zone" which would become an industrialization center.

The Commonwealth Development Corp. (CDC) began a survey of the commercial geothermal potential of an area near Soufriere. Some exploratory drilling had been done in 1975 and steam production from two of the seven holes drilled amounted to about 1 megawatt of electricity. CDC is the major shareholder and manager of St. Lucia Electricity Services. Castries Town Council and the St. Lucia Government are partners in the geothermal development project.

TRINIDAD AND TOBAGO

Petroleum dominates the economy of Trinidad and Tobago and has contributed substantially to the economic growth and stability of the islands. With the increases in heavy crude oil demand and oil prices since 1973, the Government has accumulated a capital surplus which has been used in a continuing effort to develop and diversify the agricultural and industrial sectors of the economy in order to reduce future economic dependence on hydrocarbon revenue. Recent offshore oil and gas discoveries have reversed a slight downward production trend. Government incentives directed toward land reform, agricultural development and diversification, and industrial decentralization show indications of general support as population trend studies revealed a visible shift away from the urban center toward rural and suburban areas. The construction materials sector benefited from high levels of demand resulting from this industrial and residential growth.

Last year's crude oil production decline was reversed as output rose to a daily average of 230,000 barrels, representing an 8% increase over the 1976 rate and a 7% increase over 1975 daily production. Offshore operations contributed over 80% of total crude oil production. Amoco Trinidad Oil Co. Ltd., the major offshore operator, accounted for almost 74% of the total offshore production. Amoco increased its offshore production 15% over 1976 by the completion of new wells in the Poui Field and added capacity at the Point Galeota terminal. The second major offshore company, Trinidad Northern Areas Ltd., contributed 25% of total offshore crude production. This represents a slight decline from Trinidad Northern's 1976 output and was caused by delays in alterations and development drilling. Onshore production showed a slight increase over that of 1976, due principally to increased production by the Trinidad and Tobago Oil Co. Ltd. (Trintoc) and Trinidad-Tesoro Petroleum Corp. Texaco, Inc., commanded 41% of total onshore production, followed by Trinidad-Tesoro with 39%, Trintoc with 18%, and Premier Consolidated with less than 1%.

The South East Coast Consortium, consisting of Texaco Trinidad Inc. (operator), Trintoc and Trinidad-Tesoro Petroleum Corp., continued its successful oil and gas exploratory drilling in Block L off the southeast coast of Trinidad and planned to construct platform and production facilities. Deminex, a West German company, and Occidental Petroleum Corp. (United States) have both had encouraging gas discoveries off the north coast of Trinidad. The Government negotiations with Texaco for joint ownership of the 350,000-barrel-per-day refinery at Pointe-a-Pierre in southern Trinidad, were unresolved at yearend. The Texaco refinery operated at 61% of capacity in 1977 and projections for 1978 were not optimistic. The government-owned Trintoc refinery, operated at about 60% of its 100,000-barrel-per-day capacity in 1977.

The Government of Trinidad and Tobago announced that two U.S. companies, Tenneco Trinidad LNG Inc. and Peoples Overseas Inc. (subsidiaries of Tenneco Corp. and Peoples Gas Corp.), will join the Government in

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development of the LNG project to be located at Point Lisas, Trinidad. Capacity levels will be based on the results of an ongoing survey of the country's gas reserves. Tenneco and Peoples will purchase LNG on a 20-year contract with first delivery expected in 1983.

High on the list of the Government's industrial expansion projects was the 450,000-ton-per-year integrated direct reduction steel billet plant on the Point Lisas Industrial Estate. The government-owned Iron and Steel Co. of Trinidad and Tobago Ltd (ISCOTT) has started construction of phase one despite the withdrawal of its partners, Estel N V Hoesch-Hoogovens, Kawasaki Steel and Mitsui Co., last year. Phase one of the three-phase plant construction has been scheduled for completion in 1979.

Plans for a 200,000-ton-per-year aluminum smelter at Point Lisas received at least a temporary setback when the Government's two projected partners, Jamaica and Guyana, withdrew from participation in 1976. The Government now envisions the smelter project as a one-nation endeavor and requested bids for a feasibility study on a 75,000-ton-per-year facility.

[1]Physical scientist, Branch of Foreign Data.
[2]Includes the following countries: Bulgaria, Cuba, Czechoslovakia, the German Democratic Republic, Hungary, Mongolia, Poland, Romania, and the U.S.S.R.

Table 9.—Trinidad and Tobago: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum metal including alloys, all forms	51	49
Copper metal including alloys, all forms	r456	577
Iron and steel:		
Scrap	r1,429	7,722
Steel primary forms	7	8
Semimanufactures	1,516	1,789
Lead:		
Ore	54	94
Oxide	25	49
Metal including alloys, all forms	1	(1)
Platinum waste and sweepings, troy ounces	3,246	4,315
Silver metal including alloys, do.	9,677	4,321
Tin metal including alloys, all forms	(1)	(1)
Zinc metal including alloys, all forms	(1)	(1)
NONMETALS		
Barite	7,067	183
Cement hydraulic, value, thousands	$2,206	$542
Clays and clay products, including refractory brick[2]	105	41
Diatomite and other infusorial earth	18	--
Fertilizer materials, manufactured:		
Nitrogenous	108,816	122,352
Other including mixed	86	(1)
Ammonia	200,078	180,165
Lime	2,029	1,319
Salt	113	58
Sodium and potassium compounds	5	29
Stone and sand and gravel:		
Dimension stone:		
Crude	1,798	711
Worked	(1)	1
Gravel and crushed stone	(1)	2
Sand	99	174
Sulfur, sulfuric acid, including oleum	560	190
Other nonmetals, n.e.s	(1)	--
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	30,938	28,153
Hydrogen, helium, rare gases	4	13
Petroleum:		
Crude and partly refined, thousand 42-gallon barrels	55,135	55,081
Refinery products:		
Gasoline, do.	6,472	8,294
Jet fuel, do.	2,901	4,109
Kerosine, do.	3,824	6,329
Distillate fuel oil, do.	9,400	11,642
Residual fuel oil, do.	40,665	63,136
Lubricants, do.	498	14

See footnotes at end of table.

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Table 9.—Trinidad and Tobago: Exports and reexports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976
MINERAL FUELS AND RELATED MATERIALS —Continued		
Petroleum —Continued		
Refinery products —Continued		
Other thousand 42-gallon barrels	183	1,300
Total do	63,943	94,824
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	99,136	132,335

ʳRevised.
¹Less than 1/2 unit.
²Partial data: excludes quantities valued at $1,662 in 1975 and $1,442 in 1976.

Table 10.—Trinidad and Tobago: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum:		
Alumina	302	317
Metal including alloys, all forms	838	830
Arsenic, trioxide, pentoxide, acid	(¹)	3
Copper:		
Copper sulfate	23	64
Metal including alloys, all forms	1,136	4,383
Iron and steel:		
Pig iron, ferroalloys, similar materials	22	75
Steel, primary forms	5,437	14,632
Semimanufactures:		
Bars, rods, angles, shapes, sections	22,110	27,289
Universals, plates, sheets	32,536	37,631
Hoop and strip	273	164
Rails and accessories	16	37
Wire	54,294	5,189
Tubes, pipes, fittings	141,980	50,572
Castings and forgings	5	10
Lead:		
Oxide	108	301
Metal including alloys, all forms	618	560
Nickel metal including alloys, all forms	ʳ6	4
Platinum-group metals and silver:		
Metal including alloys:		
Platinum group troy ounces	1,686	12
Silver do	87,692	125,782
Tin metal including alloys, all forms	ʳ18	23
Titanium ore and concentrate	30	--
Zinc metal including alloys, all forms	ʳ25	--
Other metals including alloys, all forms	23	72
NONMETALS		
Abrasives, natural n.e.s	41	51
Asbestos	76	14
Barite and witherite	30,548	32,669
Cement	3,515	11,066
Chalk	465	803
Clays and clay products, including all refractory brick:		
Crude clays, n.e.s	3,634	5,564
Products²	2,459	1,500
Diamond carats	37,945	336,804
Diatomite and other infusorial earth	67	47
Feldspar	314	932
Fertilizer materials:		
Natural	322	370
Manufactured:		
Nitrogenous	44	493
Phosphatic	1,372	762
Potassic	4,373	4,485
Other including mixed	271	451
Ammonia	63,473	21,879
Gypsum	14,878	13,590
Lime	1,472	429
Magnesite	5	(¹)

See footnotes at end of table.

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Table 10.—Trinidad and Tobago: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS —Continued			
Mica, all forms		40	110
Pigments, minerals		5	10
Precious and semiprecious stone, except diamond, natural and manufactured	carats	55,520	18,144
Salt		237,817	9,182
Sodium and potassium compounds, n.e.s.:			
Sodium hydroxide		5,344	8,634
Potassium hydroxide, sodic and potassic peroxides		36	16
Stone, sand and gravel:			
Dimension stone:			
Crude		r1	46
Worked		26	30
Gravel and crushed stone		643	1,558
Sand		252	145
Sulfur:			
Elemental		16	24
Sulfuric acid		581	304
Talc		135	394
Other nonmetals, n.e.s., crude			
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		63	135
Coal, coke, briquets		320	131
Hydrogen, helium, rare gases		130	147
Peat		195	2
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	56,759	87,410
Refinery products:			
Gasoline	do.	(1)	(1)
Kerosine and jet fuel	do.	(1)	(1)
Distillate fuel oil	do.	--	(1)
Residual fuel oil	do.	90	551
Lubricants	do.	195	140
Liquefied petroleum gas	do.	29	23
Other	do.	2	3
Mineral jelly and wax	do.	9	5
Total	do.	325	722

rRevised.
1Less than 1/2 unit.
2Partial figure. Excludes quantity valued at $558,341 in 1975 and $389,863 in 1976.

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The Mineral Industry of Central American Countries

By Staff, Branch of Foreign Data

CONTENTS

	Page		Page
Belize	1153	Honduras	1166
Costa Rica	1156	Nicaragua	1167
El Salvador	1159	Panama	1170
Guatemala	1162		

BELIZE[1]

Mining activity during 1977 was limited to the production of limestone, marl, and sand and gravel, all of which were used domestically. Public works projects consumed the major portion of the construction material produced.

The consortium of oil companies operating as Esso Ventures Inc., drilled one exploratory well off the coast of southern Belize. For drilling the well, Exxon Corp. received a 57% working interest in the consortium's concession located 40 kilometers east of Punta Gorda. No other offshore drilling was attempted in 1977. Esso also drilled a well on the Anschutz Overseas Inc. concession in the Toledo District of southeastern Belize. The attempt was abandoned, but seismic activities continued.

To the north of Esso's offshore acreage, Reef Exploration, Ltd., of Houston, Tex., received 18 offshore licenses covering 7,249 square kilometers. In 1975, Chevron Oil Co. had abandoned this same area after drilling a dry hole.

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Table 1.—Central American Countries: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
BELIZE			
Limestone[e]	263,000	1,200,000	197,500
Marl[e]	38,000	[r]120,000	914,000
Sand and gravel[e]	334,000	[r]365,000	666,000
COSTA RICA			
Cement	329,677	361,988	405,907
Clays:			
Kaolin	[r]227	500	460
Refractory cubic meters	[r]500,000	NA	NA
Other do.	[r]40,000	NA	NA
Diatomite	[r e]1,000	717	680
Fertilizer materials, manufactured:			
Nitrogenous, gross weight	42,421	45,530	50,098
Mixed and unspecified, gross weight	[r]290	741	826
Gold[e] troy ounces	18,000	9,600	12,200
Lime	15,000	[e]15,000	[e]15,000
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	502	363	[e]757
Kerosine do.	168	159	[e]285
Distillate fuel oil do.	455	440	[e]444
Residual fuel oil do.	[r]749	719	[e]976
Other do.	66	66	[e]172
Refinery fuel and losses do.	53	37	[e]122
Total do.	1,993	1,784	[e]2,756
Pumice cubic meters	3,000	2,000	2,120
Salt, marine	15,711	20,000	27,000
Silver[e] troy ounces	3,000	[r]1,608	1,350
Stone, sand and gravel:			
Crushed rock and rough stone cubic meters	950,000	450,000	518,000
Limestone and other calcareous materials	134,587	52,000	57,000
Sand and gravel cubic meters	215,000	190,000	224,000
EL SALVADOR			
Aluminum metal, semimanufactures	1,361	1,621	1,950
Cement	331,815	322,165	375,000
Fertilizers, manufactured:			
Nitrogenous	} 98,547	13,095	64,853
Phosphatic		20,061	21,249
Mixed		112,533	97,697
Gold, fine troy ounces	8,713	3,007	2,156
Gypsum[e]	6,000	6,000	7,000
Iron and steel, steel semimanufactures	25,049	21,358	27,575
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	980	1,095	1,213
Jet fuel do.	354	371	} 372
Kerosine do.	--	--	
Distillate fuel oil do.	1,489	1,469	1,601
Residual fuel oil do.	1,459	1,763	1,678
Other:			
Liquefied petroleum gas do.	215	} 147	316
Asphalt do.	154		{ 134
Refinery fuel and losses do.	228	237	84
Total do.	4,879	5,082	5,398
Salt[e]	23,000	23,000	25,000
Silver, fine troy ounces	176,496	166,289	112,245
Limestone	503,621	486,016	560,000
GUATEMALA			
Antimony, mine output, metal content	856	1,120	918
Cement	389,354	445,369	490,848
Clays	[r]102,160	96,375	104,830
Copper, content of concentrates	2,560	2,889	2,064
Feldspar	[e]30,000	[r e]20,000	13,071
Gypsum, crude:			
For cement	12,319	13,696	13,324
Other	NA	NA	18,835
Iron ores, gross weight	6,000	2,578	3,166
Lead:			
Mine output, metal content[e]	100	100	100
Metal, including secondary	225	110	127
Lime	34,631	45,514	45,581
Nickel, mine output, metal content[1]	--	--	298

See footnotes at end of table.

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Table 1.—Central American Countries: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
GUATEMALA —Continued			
Petroleum:			
Crude thousand 42-gallon barrels	--	--	33
Refinery products:			
Gasoline do	[r]1,300	927	1,111
Jet fuel do	211	229	265
Kerosine do	307	218	233
Distillate fuel oil do	[r]1,625	1,698	1,474
Residual fuel oil do	[r]1,854	1,875	2,009
Other:			
Liquefied petroleum gas do	[r]89	68	43
Unspecified do			
Refinery fuel and losses do	[r]169	172	63
Total do	[r]5,555	5,187	5,198
Salt	8,800	10,924	10,610
Stone, sand and gravel:			
Crushed and broken:			
Limestone thousand tons	848	945	941
Volcanic ash do	15	24	26
Unspecified (blast, etc.) do	NA	NA	903
Marble cubic meters	1,200	1,337	1,492
Quarts	NA	2,755	NA
Sand and gravel:			
Silica sand	NA	NA	40,074
Other cubic meters	792,041	868,369	844,223
Tungsten, concentrate (W content)	1	--	--
Zinc, mine output, metal content (exports)	[2]300	457	1,024
HONDURAS			
Antimony, mine output, metal content	103	117	70
Cadmium, mine output, metal content	230	231	263
Cement	298,000	222,170	377,000
Copper, mine output, metal content[3]	[e]200	364	535
Gold troy ounces	2,520	2,280	2,481
Gypsum	1,050	[r e]10,000	18,144
Iron and steel, steel semimanufactures	NA	NA	26,308
Lead, mine output, metal content	23,263	[e]23,000	23,541
Limestone	NA	NA	496,457
Marble	NA	NA	42,184
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	716	701	713
Jet fuel do	86	77	76
Kerosine do	245	270	299
Distillate fuel oil do	1,223	1,368	1,251
Residual fuel oil do	1,949	891	616
Other:			
Liquefied petroleum gas do	[r]92	72	60
Unspecified do			
Refinery fuel and losses do	[r]236	71	273
Total do	[r]4,547	3,450	3,288
Salt	[r]30,797	[r e]15,000	2,359
Silver thousand troy ounces	3,802	[e]3,502	3,210
Zinc, ore and concentrate, metal content	30,298	[e]27,500	27,806
NICARAGUA[4]			
Cement	176,848	208,717	220,766
Copper, mine output, metal content	[r]1,481	1,264	[e]600
Gold, mine output, metal content troy ounces	[r]83,457	75,841	65,764
Gypsum and anhydrite, crude[e]	35,000	[r]30,000	36,000
Lead ore and concentrate, metal content	[r]1,383	631	956
Lime[e]	46,000	[r]46,000	47,000
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	1,197	1,010	1,421
Jet fuel do	295	185	338
Kerosine do	--	145	
Distillate fuel oil do	1,150	1,231	1,388
Residual fuel oil do	1,608	1,650	1,762

See footnotes at end of table.

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Table 1.—Central American Countries: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	1977[p]
NICARAGUA[4] —Continued			
Petroleum refinery products —Continued			
Other:			
Liquefied petroleum gas _ thousand 42-gallon barrels	155	188	185
Asphalt _ do	185	150	112
Unspecified _ do	52	67	58
Refinery fuel and losses _ do	[r]217	211	122
Total _ do	[r]4,859	4,837	5,386
Salt, marine[e]	12,000	14,000	16,000
Stone, sand and gravel _ cubic meters	NA	NA	[e]76,038
Silver, mine output _ troy ounces	[r]434,675	208,217	153,492
Zinc, ore and concentrate, metal content	[r]11,177	14,330	10,142
PANAMA			
Cement	[r]277,504	282,673	270,672
Clays and clay products:			
Crude	189,382	272,012	207,611
Products _ cubic meters	([5])	45,128	34,157
Gas, manufactured _ thousand cubic feet	[e]443,500	NA	NA
Petroleum refinery products:[e]			
Gasoline _ thousand 42-gallon barrels	2915	2,343	2,500
Jet fuel _ do	2,439	1,936	1,850
Kerosine _ do	175	143	250
Distillate fuel oil _ do	4,787	4,626	4,500
Residual fuel oil _ do	15,666	9,639	10,100
Other:			
Liquefied petroleum gas _ do	} 398	{ 346	--
Asphalt _ do		101	50
Unspecified _ do	1,100	407	1,350
Refinery fuel and losses _ do	1,320	838	800
Total _ do	28,800	20,379	21,400
Salt, marine	29,243	12,514	21,021
Stone, sand and gravel:			
Limestone[e]	20,589	211,381	307,371
Other _ thousand cubic meters	1,729	398	371

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] Content of sinter.

[2] Revised from none.

[3] From lead and zinc concentrates.

[4] In addition to the commodities listed, Nicaragua produces a small but undetermined quantity of cadmium contained in zinc concentrates produced for export.

[5] Produced 60,000 metric tons in 1975.

[6] Totals for each year exclude the amount reported in volumetric units of 8,000 cubic meters.

COSTA RICA[1]

New mining legislation has been under consideration by Costa Rica in response to general concerns that present laws do not properly protect the national interest or establish sufficient Government control over mineral resource exploitation and resulting benefits. Uncertainty regarding the final version of the anticipated new mining law has resulted in considerable hesitancy on the part of investors to seek new exploration concessions and a reluctance on the part of the Government to award them. As a result, no new mineral exploration permits have been issued.

Martin Marietta Aluminum, Inc. continued to study the feasibility of joining with the Government, The Aluminum Co. of America (Alcoa), and possibly a Japanese company to construct a 250,000-ton-per-year aluminum smelter. The smelter would consume about two-thirds of the energy produced at the proposed 760-megawatt-capacity Boruca hydroelectric project and obtain alumina from Martin Marietta's proposed refinery on St. Croix, the Virgin Islands. In 1976, Alcoa abandoned the low-grade (30% alumina content) bauxite deposit located in southern Costa Rica after studies indicated that it would be uneconomical to develop. Tecno Hunter Engineer-

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ing S.p.A. of Italy and State-owned Corp. Costarricense de Desarrolla (CODESA) planned to construct a 10,900-ton-per-year-capacity plant near Puntarenas for the manufacture of finished aluminum products. The plant should be operational in 2 or 3 years and will use imported ingot.

In 1975, studies were initiated to determine the feasibility of constructing a geothermal powerplant on the slopes of the Miravalles and Rincón de la Vieja Volcanos in the Province of Guanacaste. Results were encouraging, and in 1977, the Government obtained additional funds from the Inter-American Development Bank to drill several deep holes to establish an economic basis for further development.

Cía. Minera de Guanacaste was the only producer of gold and silver in 1977. Total production was estimated at 12,250 troy ounces of gold and 1,350 troy ounces of silver. The company worked the San Martín and Tres Hermanos veins, which have ore reserves of about 272,000 tons averaging 0.33 troy ounces of gold per ton. In 1976, Bulora Corp. Ltd. suspended operations at the El Líbano gold mine southeast of Tilarán but was reported to be continuing exploration. After being closed for 30 years, the Sacra Familia y Cía. gold mines in the Aguacate area were reportedly ready to commence production with a combined milling capacity of 100 tons of ore per day.

United Hearne Resources Ltd., a Canadian company, continued its evaluation of the Santa Clara low-grade, gold-silver deposit. With the feasibility study more than half completed, ore reserve estimates were increased to over 5 million tons grading 0.11 troy ounces of gold and a small amount of silver per ton. United Hearne holds the property under option from Barranca Corp., which retained a 30% interest. United Hearne was also reported to be interested in the Playa Camerones property located to the north of Santa Clara.

Table 2.—Costa Rica: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal including alloys, unwrought and semimanufactures	331	264	Nicaragua 82; El Salvador 68; Guatemala 57.
Copper metal including alloys, all forms	--	38	Panama 34.
Iron and steel including alloys, all forms	7,641	21,041	Nicaragua 12,482; El Salvador 4,029; Panama 2,659.
Zinc metal including alloys, all forms	--	3	All to Nicaragua.
Other nonferrous base metals including alloys, all forms	[1]58	2	Do.
NONMETALS			
Abrasives, natural: Grinding and polishing wheels and stones	114	153	Mainly to Nicaragua.
Cement	2,705	3,996	Mainly to Panama.
Clays and clay products including nonclay refractory brick	135	217	Nicaragua 174; Honduras 37.
Diatomite and other infusorial earth	780	1,280	All to El Salvador.
Fertilizer materials, manufactured:			
Nitrogenous	16,465	12,099	Mexico 10,849; Panama 1,129; Honduras 120.
Potassic	80	1	All to Panama.
Other, including mixed	51,209	92,171	Mexico 53,442; Panama 19,909; Nicaragua 5,973.
Lime	208	587	Panama 442.
Stone:			
Dimension	76	44	All to Guatemala.
Other	1,409	1,438	Panama 1,147; El Salvador 176; Honduras 66.
Other: Building materials of asphalt, asbestos and fiber cement, and unfired nonmetals, n.e.s	398	4,188	Guatemala 2,472; Honduras 1,385; Panama 261.
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline, thousand 42-gallon barrels	([2])	([2])	All to bunkers.
Distillate fuel oil, do.	17	41	Mainly to bunkers.
Lubricants, do.	([2])	1	All to bunkers.

[1]May include aluminum scrap.
[2]Less than 1/2 unit.

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Table 3.—Costa Rica: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS[1]			
Aluminum metal including alloys, all forms	2,593	3,924	France 1,145; United States 1,021; El Salvador 453.
Copper:			
Copper sulfate	17	17	United Kingdom 10; West Germany 6.
Metal including alloys, all forms	1,565	1,967	Chile 1,237; United States 189; Mexico 158.
Iron and steel metal:			
Scrap	4	(2)	All from United States.
Pig iron, ferroalloys, similar materials	428	405	West Germany 384; Brazil 21.
Steel, primary forms	28,854	44,549	United States 29,283; Canada 8,732; Chile 4,166.
Semimanufactures	60,274	84,954	Japan 62,802; West Germany 5,524; United States 4,704.
Lead metal including alloys, all forms	144	277	Panama 101; Denmark 82; United States 29.
Nickel metal including alloys, all forms	6	6	United States 3; United Kingdom 1; Japan 1.
Platinum-group metals including alloys, all forms troy ounces	8,649	9,099	All from United States.
Silver metal including alloys do	8,906	65,137	France 52,019; United States 9,099; Canada 3,922.
Tin metal including alloys, all forms	1,158	3,495	Mexico 2,361; Canada 432; Japan 288.
Other:			
Ore and concentrate of nonferrous base metals, n.e.s	502	816	Mexico 519; Japan 295.
Waste and scrap of nonferrous base metals	10	6	All from Panama.
Metals:			
Pyrophoric alloys	1	1	Mainly from United States.
Nonferrous base metals including alloys, all forms, n.e.s	16	11	United States 9; Spain 1.
NONMETALS			
Abrasives, natural, n.e.s	79	75	West Germany 23; United States 19; United Kingdom 8.
Asbestos	2,974	1,417	Canada 1,087; Botswana 151; Australia 83.
Boron materials, oxide and acid	45	24	United States 17; West Germany 5; Turkey 2.
Cement	3,783	3,248	Japan 1,709; Belgium-Luxembourg 1,497.
Clays and clay products (including all refractory brick):			
Crude	1,763	2,445	United States 1,309; United Kingdom 631.
Products:			
Refractory (including nonclay bricks)	2,018	1,333	United States 761; Canada 470; Spain 49.
Nonrefractory	4,438	3,632	Nicaragua 2,794; Panama 125; United States 107.
Diamond, industrial carats	15,000	135,000	Guatemala 115,000; United States 15,000.
Diatomite and other infusorial earth	300	440	Mexico 386; Nicaragua 28; United States 25.
Feldspar, fluorspar, cryolite	311	804	Nicaragua 50; Guatemala 185; United States 106.
Fertilizer materials:			
Crude, phosphatic, potassic	1	9	West Germany 8.
Manufactured:			
Nitrogenous	49,358	26,821	Netherlands 6,360; Trinidad and Tobago 4,895.
Phosphatic	56,329	88,277	United States 61,915; Mexico 22,838.
Potassic	47,296	45,715	United States 23,283; Canada 10,429.
Other, including mixed	5,615	14,332	Mexico 5,160; Colombia 4,209; West Germany 3,333.
Graphite, natural	8	17	West Germany 7; Netherlands 5; Canada 5.
Lime	785	877	Nicaragua 776; Guatemala 86.
Mica, all forms	17	20	West Germany 10; United States 10.
Precious and semiprecious stone, including gem diamond kilograms	45	71	United States 21; West Germany 19.
Salt and brines	7,691	8,931	Nicaragua 8,145; United States 534.
Sodium compounds, n.e.s.:			
Caustic soda	4,491	4,790	Nicaragua 4,551; United States 141.
Soda ash	978	1,313	Netherlands 896; West Germany 313; Colombia 80.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	477	564	Nicaragua 359; Guatemala 108; Italy 96.
Worked	55	34	Guatemala 19; Nicaragua 14.
Industrial stone	52	28	United States 17; Nicaragua 11.
Sand, gravel, and crushed rock, n.e.s	644	206	United States 195; Taiwan 11.
Other	(2)	1	All from United States.

See footnotes at end of table.

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Table 3.—Costa Rica: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Sulfur:			
Elemental, all forms	160	100	All from United States.
Sulfur dioxide	19	(2)	Do.
Sulfuric acid	450	555	El Salvador 389; Guatemala 137.
Talc, soapstone, pyrophyllite	439	591	United States 344; Italy 122; Taiwan 80.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	1,652	1,842	Venezuela 925; Colombia 722; United States 137.
Coal and coke, including briquets	503	393	West Germany 222; Colombia 91; United States 64.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	1,995	1,839	Venezuela 1,345; Netherlands Antilles 494.
Refinery products:			
Gasoline do	672	712	Venezuela 523; Netherlands Antilles 130.
Kerosine do	91	97	Trinidad and Tobago 48; United States 25.
Distillate fuel oil do	1,905	1,790	Venezuela 1,465; Netherlands Antilles 325.
Lubricants do	107	115	United States 41; Netherlands Antilles 30.
Other:			
Liquefied petroleum gas do	99	96	Panama 84; NNicaragua 11.
Naphtha do	(2)	(2)	Mainly from Netherlands Antilles.
Paraffin do	17	15	West Germany 11; United States 2.
Petroleum do	1	2	Mainly from United States.
Unspecified do	103	91	Do.
Total do	2,995	2,918	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	2,010	2,263	NA.

NA Not available.

[1]Metal oxides and hydroxides excluded because they were reported inseparably from metal salts and other compounds.

[2]Less than 1/2 unit.

EL SALVADOR[1]

Gold and silver remained the major mineral products in this country, which is economically dominated by coffee, cotton, and sugar export crops. El Salvador had not yet issued permits to explore for petroleum. The Government, however, made arrangements for the preparation of a draft for new legislation governing hydrocarbon exploration.

Minas San Cristóbal S.A., a subsidiary of Javelin Corp. (United States), suffered considerable production declines, primarily owing to the expansion of the San Cristóbal mill, formerly known as the Montecristo mill. The 200-ton-per-day-capacity mill can now accommodate the additional production from several smaller mines nearby, and it was anticipated that gold and silver output would return to previous levels. The company continued to investigate deposits at Divisadero and Gigante.

Commerce Group Corp. encountered difficulties in maintaining economic gold ore reserves at its San Sebastián mine in La Union Department and continued exploration for additional reserves. Bruneau Mining Corp., a subsidiary of Rosario Resources Corp., continued its exploration studies at the old El Dorado gold mine in Cabañas Department.

The iron industry operated well below capacity in 1977. Even so, one company, Borgonovo Group, initiated studies of the Central American market for expansion feasibility. The following companies are involved in producing iron ingots and products:[2] Aceros S.A. (Borgonovo Group), with an annual capacity of 30,000 tons of iron products, mostly construction rods and wire; Corp. Industrial Centroamericana S.A. (CORINCA), with an annual capacity of 30,000 tons of iron rods for construction; Siderúrgica Salvadoreña (Tinetti y Cía.), with an annual capacity of 25,000 tons of iron rods for construction and tools; and Siderúrgica Centroamericana del Pacífico,

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S.A. (Borgonovo Group), with an annual capacity of 100,000 tons of iron ingots, inaugurated in January 1977 to supply ingots to Aceros and to other Central American founderies, primarily Guatemalan.

Power generation continued to receive priority Government attention during 1977, and El Salvador claimed to be on the verge of self-sufficiency. In February, the 135-megawatt, Cerro Grande hydroelectric plant opened. Financing was secured for the San Lorenzo hydroelectric plant, a 165-megawatt facility to be constructed on the Lempa River. Approval was given for installation of the final 35-megawatt unit at the Ahuachapán geothermal power station. A Japanese company, Fuji Electric Co., Ltd., will construct the unit; installation was scheduled for 1979. The Ahuachapán station will then have a 95-megawatt capacity.

Additional geothermal power capacity was actively pursued through the investigation of sites for two 35-megawatt plants. Two sites in western El Salvador, Toles and Chimilapa, have been tested; two other western sites, Berlín and Chinameca, and two centrally located sites, San Vicente and Parras Lempa, are under exploration. The Comisión Ejecutiva Hidroeléctrica del Río Lempa (CEL) has responsibility for geothermal development.

Table 4.—El Salvador: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum metal including alloys, all forms	1,424	2,016
Copper metal including alloys, all forms	r84	(1)
Lead metal including alloys, all forms	--	18
Iron and steel, semimanufactures	r10,570	8,710
Platinum-group metals including alloys, all forms ---troy ounces	1,479	--
Silver metal including alloys, all forms ---do	r176,411	168,534
Tin metal including alloys, all forms	r7	8
Zinc metal including alloys, all forms	--	1
Other: Ash and residue containing nonferrous metals	62	364
NONMETALS		
Abrasives, natural	190	167
Cement	66	168
Clays:		
Kaolin	317	1,384
Refractory, unspecified	1	2
Fertilizer materials	r28,615	69,650
Lime	5	39
Salt	19,270	20,337
Stone:		
Crude and partly worked	45	1
Worked	r66	245
Sulfur, sulfuric acid	1,895	1,920
MINERAL FUELS AND RELATED MATERIALS		
Petroleum refinery products:		
Gasoline ---thousand 42-gallon barrels	(2)	(1)
Distillate fuel oil ---do	r20	10
Lubricants ---do	83	81
Liquefied petroleum gas ---do	47	46
Unspecified ---do	110	77

rRevised.
[1]Less than 1/2 unit.
[2]Revised to zero.

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Table 5.—El Salvador: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS			
Aluminum metal including alloys:			
Unwrought		648	1,835
Semimanufactures		1,614	3,245
Copper:			
Copper sulfate		1	14
Metal including alloys, all forms		1,540	2,762
Iron and steel metal:			
Scrap		44	30
Pig iron, ferroalloys, similar materials		133	166
Steel, primary forms		27,074	10,626
Semimanufactures		37,809	51,733
Lead metal including alloys, all forms		250	191
Platinum-group metals	troy ounces	32	64
Silver:			
Ore and concentrate	do	11,863	24,499
Metal including alloys, all forms	do	23	21
Tin metal including alloys, all forms		498	537
Zinc metal including alloys, all forms		--	289
Other:			
Ore and concentrate		3	1
Ash and residue containing nonferrous metals		51	(1)
Base metals including alloys, all forms		8	2
NONMETALS			
Abrasives, natural		1,359	1,043
Asbestos		3,866	2,637
Cement		11,086	7,020
Clays and clay products (including all refractory brick):			
Crude:			
Kaolin		4,322	3,634
Refractory clay, unspecified		93	255
Products		2,030	2,401
Diamond, industrial	thousand carats	r175	1,115
Diatomite and other infusorial earth		1,295	2,335
Feldspar and fluorspar		1	1
Fertilizer materials, crude and manufactured:			
Nitrogenous		181,145	297,235
Phosphatic		48,439	45,770
Potassic		8,022	1,268
Other, including mixed		22,886	30,636
Graphite, natural		4	64
Gypsum and plasters		8,425	8,385
Lime		6,889	5,599
Mica, all forms		4	4
Pigments, mineral, crude		2,399	1,986
Salt		55	84
Sodium compound, n.e.s.:			
Sodium carbonate		1,258	1,321
Sodium hydroxide		6,298	7,915
Stone, sand and gravel:			
Dimension		3,617	4,263
Gravel and crushed rock		930	1,244
Sand		682	199
Sulfur:			
Elemental, all forms		4,520	5,186
Sulfuric acid		1,021	7,708
Talc, soapstone, pyrophyllite		140	127
Other nonmetals, n.e.s.		312	257
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		53	4,978
Coal and coke, including briquets		572	501
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	3,623	3,603
Refinery products:			
Gasoline	do	30	27
Kerosine	do	12	16
Lubricants	do	r34	40
Other:			
Liquefied petroleum gas	do	(1)	(1)
Mineral jelly and wax	do	13	17
Unspecified	do	1	1
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		52	34

rRevised.
1Less than 1/2 unit.

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GUATEMALA[3]

Guatemala's basic policy toward the development of its mineral resources continued to be one of realizing maximum benefits without committing national funds to investment capital. The Government benefits accrue from foreign exchange revenue, added-tax revenue, employment, and the December 1975 revision to petroleum legislation that granted to the State 55% of all production as well as the first option on the purchase of the remaining production.

Reconstruction requirements resulting from the 1976 earthquake have added to the chronic cement shortage. Needs are estimated to be about 30,000 bags per day more than current production capacity. In 1977, Guatemala imported cement from El Salvador and Mexico. New cement plant construction and expansion of existing plants will not afford relief until 1979.

Following 4 years of construction and an investment of $231 million, Exploraciones y Explotaciones Mineras Izabal S.A. (EXMIBAL), inaugurated its new nickel laterite mine and pyrometallurgical process plant on July 12, 1977. The plant is located on the northwestern shore of Lake Izabal near the town of El Estor in eastern Guatemala. At full capacity, the plant will produce 25 million pounds of nickel per year in the form of 75% nickel matte.

The EXMIBAL nickel deposits are of the lateritic type, and are the product of the weathering and residual concentration of nickel from olivine-rich peridotite rocks. Ore-quality material grading 1.5% to 2.2% nickel occurs in a rubbly saprolitic zone of decomposed bedrock, overlain by an average overburden of 8 meters of subeconomic limonite grading 1% to 1.7% nickel. Nickel reserves are scattered on eight separate deposits around the lake. Reserves at the La Gloria mine and at the Manto 4 and Amates areas on the north and northwest of Lake Izabal are more than adequate to maintain a plant feed of 670,000 tons of 1.95% nickel ore per year for 20 years. Similar quality reserves are also indicated in the Cristina, Trincheras, and Cerro Colorado deposits on the south side of the lake. Total resources at a lower average nickel grade can be inferred to be substantially larger.

Processing of the EXMIBAL ore involves conversion of the nickel oxide and silicate lateritic ore to a sulfide form, produced by injecting sulfur into a 100-meter-long, 5.5-meter-diameter reduction kiln. The sulfide product is then amenable to a more conventional pyrometallurgical treatment in a 45,000-kilovolt-ampere electric furnace and two 7.6-meter-long, 4-meter-diameter standard converters. The finished matte, assaying about 75% nickel, 22% sulfur, and 1% iron, will then be granulated and dried for marketing. Commercial level operation is expected to begin in 1978. The matte will be shipped to the Inco Ltd. refinery at Clydach, Wales. Inco, a Canadian company, holds an 80% interest in EXMIBAL, and Hanna Mining Co. of the United States owns 20%. According to the terms of a 1971 agreement, over the next 10 years the Guatemalan Government will acquire a 30% interest in EXMIBAL. This acquisition will be financed by EXMIBAL with a 50% waiver of its income tax exemption during the first 5 years of operation and a 25% waiver during the next 5 years.

Basic Resources International S.A. continued to be active in Guatemalan mineral development. The company holds a nickel concession west of EXMIBAL's operation but has not initiated development procedures. Through its subsidiary, Minas de Oxec S.A., Basic Resources operated the Oxec underground copper mine west of Lake Izabal. Ore reserves were estimated at 750,000 tons averaging 2.6% copper. The 400-ton-per-day concentrator produced about 13,071 tons of copper concentrate in 1977, all of which was shipped to Spain for refining.

In 1977, Basic Resources joined Veitscher Magnesitwerke AG of Austria to form an equally owned subsidiary, Magnesite International Bahamas, Ltd. The newly formed company will develop 7 million tons of proved and probable magnesite ore reserves located north of Lake Izabal at Minas Saquipec. The ore has been reported as containing 40% to 45% magnesite. By using open pit mining methods, the company expected to process 300,000 tons of ore per year to produce some 30,000 tons of dead-burned magnesite. No date has been given for startup of production.

The Guatemalan and Japanese Governments joined in a cooperative search for zinc deposits. The exploration was concentrated in a 14-square-kilometer area in the

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Huehuetenango and Quiché Departments of southwestern Guatemala, where completed geological and geochemical surveys were to be augmented by topographic mapping and drilling. Minas y Minerals Centro America has also been investigating the zinc potential east of the town of Huehuetenango. This small private company was reported to have installed a 60-ton-per-day zinc concentrator and was investigating veins near the old Almengores mine.

The Government proceeded with its program to exploit hydroelectric and geothermal resources. By 1982, the Chixoy hydroelectric project on the Chixoy River will add 300 megawatts to Guatemala's hydroelectric capacity, more than doubling 1974 capacity. The Instituto Nacional de Electrificacíon (INDE) investigated several geothermal sites, two of which were expected to produce temperatures of 200° C at a 1,500-meter-depth. One of these sites is located near Lake Amatitlán south of Guatemala City, and the other is at Zunil in the western highlands.

The Shenandoah Oil Corp. and Basic Resources joint petroleum venture expanded its area of exploration to include three new areas: Chinajá Field, located some 19 kilometers northeast of Shenandoah's 1976 Rubelsanto Field discovery; the Chisec anticline, located some 13 kilometers south of Rubelsanto; and the Rio Xalbal Field, located 56 kilometers west of Rubelsanto. The well drilled at Chisec was abandoned after testing noncommercial amounts of oil. Further drilling depended on an evaluation of the data obtained. The Rio Xalbal test was abandoned after mechanical difficulties. The Chinajá well found production in three zones. The lowest zone, 6 meters thick and 1,160 meters deep, produced 3,300 barrels per day of 32.30 API gravity oil with no water; the middle zone, 4 meters thick and 1,110 meters deep, produced 3,250 barrels per day; and the shallowest zone, 4.5 meters thick and 1,038 meters deep, tested 2,000 barrels per day. Natural gas from the three zones in this well tested at 3.3 million, 3.8 million, and 0.72 million cubic feet per day, respectively. Seismic and geologic data on the Chinajá Field led to speculation that the structure may be larger in size and greater in formation porosity than the producing zone in Rubelsanto Field. Further testing was planned for 1978. The Government planned to offer exploration contracts for new areas in the northwestern highlands.

Private Guatemalan interests operating as Central American Pipeline Co. (CAPICO) have proposed construction of a 48-inch pipeline and port and storage facilities to transport Alaskan North Slope and Indonesian crude from the Pacific Ocean to the Caribbean Sea. CAPICO negotiations with the Government for approval of the project continued throughout 1977.

Table 6.—Guatemala: Exports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS			
Aluminum metal including alloys:			
Unwrought		20	36
Semimanufactures		95	278
Antimony ore and concentrates		2,361	1,525
Copper:			
Ore and concentrates		9,681	11,122
Metal including alloys:			
Unwrought		28	61
Semimanufactures		42	34
Iron and steel:			
Ore and concentrates		8	--
Metal including alloys:			
Scrap		--	166
Pig iron, sponge iron, powder		--	22
Spiegeleisen, ferro-manganese, other ferroalloys	kilograms	--	227
Iron and steel, primary forms	do	1,082	218
Semimanufactures:			
Bars, rods, angles, shapes, sections		3,267	1,425
Universals, plates, sheets, uncoated	kilograms	11,499	409
Universals, plates, sheets, coated		2,135	428
Hoops and strips of iron and steel		344	11
Iron and steel wire		73	75
Tubes, pipes, fittings		3,752	5,824
Castings and forgings, rough		--	5

See footnotes at end of table.

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Table 6.—Guatemala: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS —Continued			
Lead metal including alloys:			
Unwrought		3	5
Semimanufactures		32	33
Tin metal including alloys:			
Unwrought		2	2
Semimanufactures		91	1,226
Zinc:			
Ore and concentrates		--	160
Metal including alloys:			
Unwrought		255	135
Semimanufactures		7	15
Other:			
Nonferrous metal scrap	kilograms	--	322
Miscellaneous nonferrous base metals	do	--	592
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc.		1,514	1,338
Grinding and polishing wheels and stones		16	35
Asbestos	kilograms	44,104	136
Cement		2,407	181
Clays and clay products:			
Crude:			
Kaolin		5,287	5,685
Other		48	56
Products:			
Refractory		84	82
Nonrefractory		648	426
Diatomite and other infusorial earth		18	11
Feldspar, fluorspar, cryolite		611	1,538
Fertilizer materials:			
Crude		29	14
Manufactured:			
Nitrogenous		634	3,231
Phosphatic		21	790
Other, including mixed		140	126
Graphite, natural	kilograms	252	--
Gypsum and plasters:			
Gypsum		8,384	8,395
Plasters		20	811
Lime		4,947	6,775
Pigments, mineral, natural		2,401	1,853
Precious and semiprecious stones, natural and manufactured		56	2
Salt and brines	kilograms	11,936	92
Sodium and potassium compounds, n.e.s.	do	300	--
Stone and sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous		3,600	4,365
Slate		7	--
Other		4	2
Worked		1,454	1,088
Gravel and crushed rock		159	44
Quartz and quartzite		9	52
Other		1,936	811
Sulfur, sulfuric acid		959	7,732
Talc, steatite, soapstone, pyrophyllite		14	22
Other:			
Building materials of asphalt, asbestos, fiber cement, and unfired nonmetals		2,185	851
MINERAL FUELS AND RELATED MATERIALS			
Coal, all grades, including briquets	kilograms	700	--
Coke and semicoke		18	4
Hydrogen, helium, rare gases		47	54
Petroleum:			
Refinery products:			
Kerosine	42-gallon barrels	286	--
Distillate and residual fuel oils	do	14,320	1,143
Lubricating oils and greases	do	704	461
Mineral jelly and waxes	do	74	121
Other:			
Liquefied petroleum gas	do	754	4,084
Petroleum asphalt	do	122	101
Total	do	16,260	5,910

[1]Sources: Anuario De Comercio Exterior, 1975 and 1976, Guatemala. Dirección General De Estadistica.

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Table 7.—Guatemala: Imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum metal including alloys:		
Unwrought	216	636
Semimanufactures	1,283	1,572
Copper:		
Ore and concentrates	1,656	1,849
Copper sulfate	67	24
Metal including alloys:		
Unwrought	6	104
Semimanufactures	293	280
Iron and steel:		
Ore and concentrates	18	--
Metal:		
Scrap	5	22
Pig iron, sponge iron, powder	2	2
Spiegeleisen, ferromanganese, other ferroalloys	226	167
Iron and steel, primary forms	20,051	18,508
Semimanufactures:		
Bars, rods, angles, shapes, sections	19,747	23,724
Universals, plates, sheets, uncoated	25,793	47,160
Universals, plates, sheets, coated	3,663	14,059
Hoops and strips of iron and steel	916	945
Rails and accessories	20	15
Iron and steel wire	4,941	10,208
Tubes, pipes, fittings	4,388	4,845
Castings and forgings, rough	82	44
Lead metal including alloys:		
Unwrought	15	28
Semimanufactures	81	9
Nickel metal including alloys, all forms	10	7
Platinum-group metals including alloys, all forms kilograms	6	32
Silver metal including alloys, all forms do	23	71
Tin metal including alloys:		
Unwrought	10	22
Semimanufactures	16	8
Zinc metal including alloys:		
Unwrought	1,966	3,842
Semimanufactures	9	21
Other:		
Nonferrous metal scrap	484	95
Miscellaneous nonferrous base metals employed in metallurgy	10	14
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, etc	8	10
Grinding and polishing wheels and stones	67	75
Asbestos	1,808	2,553
Boron materials: Oxide and acid	13	16
Cement	2,407	12,134
Clays and clay products:		
Crude:		
Kaolin	3,419	13,457
Other	638	457
Products:		
Refractory	4,536	8,332
Nonrefractory	765	2,409
Diamond, industrial kilograms	4	14
Diatomite and other infusorial earth	490	518
Feldspar, fluorspar, cryolite	250	100
Fertilizer materials:		
Crude:		
Nitrogenous	60	61
Phosphatic	70	--
Other	27	11
Manufactured:		
Nitrogenous	130,837	97,305
Phosphatic	15,313	12,901
Potassic	7	63
Other including mixed	20,428	33,234
Graphite, natural	34	32
Gypsum and plasters:		
Gypsum	9	3
Plasters	36	51
Lime	43	66

See footnotes at end of table.

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Table 7.—Guatemala: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS —Continued			
Mica:			
Crude		10	59
Worked including agglomerated splittings	kilograms	185	40
Precious and semiprecious stones, natural and manufactured	do	106	72
Salt and brines		19,060	18,924
Sodium and potassium compounds, caustic soda		6,625	6,992
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked		151	73
Worked		86	460
Gravel and crushed rock		100	60
Quartz and quartzite		1,529	493
Other		388	348
Sulfur:			
Elemental, all forms		182	4,296
Sulfur dioxide		74	86
Sulfuric acid		602	432
Talc, steatite, soapstone, pyrophyllite		282	325
Other: Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals		8,478	10,901
MINERAL FUELS AND RELATED MATERIALS			
Asphalt, natural		--	2
Carbon black		1,133	871
Coal and coke:			
Coal, all grades, including briquettes		28	31
Coke and semicoke		421	495
Hydrogen, helium, rare gases	kilograms	2,049	138
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	5,700	4,542
Refinery products:			
Gasoline	do	531	994
Kerosine	do	35	111
Gas oil and diesel oil	do	491	1,031
Lubricating oils and greases	do	100	98
Mineral jelly and wax	do	51	50
Other:			
Liquefied petroleum gas	do	255	304
Petroleum asphalt	do	69	47
Total	do	1,532	2,635

[1]Sources: Anuario De Comercio Exterior, 1975 and 1976, Guatemala. Dirección General De Estadistica.

HONDURAS[1]

No changes were made during 1977 in the Honduran tax law decree, which has discouraged private investment since its passage in December 1975. In April, Canada began an aid program to assist Honduras in organizing its minerals regulatory and development efforts. The mineral industry contributed about 5% to the gross national product (GNP). The major minerals produced were gold, lead, zinc, antimony, and cadmium.

Rosario Resource's El Mochito mine was the only substantial active mining operation in Honduras. In 1977, the mill processed 325,875 tons of ore, a modest increase of about 5,000 tons over that of 1976. Metal content gradations within the ore body at the different mining levels resulted in lower silver and lead production but an increase in zinc production. For 1977, Rosario Resources reported production of 2,818,515 troy ounces of silver, 1,990 troy ounces of gold, 20,604 tons of lead, and 26,542 tons of zinc from the El Mochito mine. Mining and milling capacity expansion to about 1,400 tons per day was to be completed in 1978, and Rosario Resources anticipated that it would then have a more cost-effective operation, an important factor in light of high Honduran taxes, increasing infrastructural and milling costs, and fluctuations in the metal markets.

A Japanese firm, Hibino Metal Industrial Corp., expressed interest in assisting the many small antimony mines in western Honduras. The company has made occasional spot purchases of antimony from these operations but reportedly would like to establish a long term supply source for perhaps 3,600 tons per year of antimony in

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concentrates.

A new 60,000-ton-per-year-capacity steel-mill was opened by Aceros Industriales S.A., and consideration was being given to establishing a 60,000-ton-per-year scrap iron furnace. Other mineral development prospects for coal, iron ore, and marble remained in investigative or assessment phases of consideration.

Geonomics Inc., a California company, contracted with Empresa Nacional de Energía Eléctrica (ENEE) to carry out a $750,000 investigation of geothermal resources in five areas of Honduras. The areas cover approximately 10,000 square kilometers and include Choluteca, San Ignacio, Comayagua, Balfate-La Ceiba, and La Masica. It was anticipated that field work would be completed early in 1978.

In May, the Government revised those provisions of the Petroleum Law of 1972 dealing with granting concessions. The new regulations, set forth in Decree No. 457 dated May 11, 1977, required all concessions to be issued solely through public bidding. In August, the Government offered three concession blocks for international public bid. The blocks included some offshore Atlantic acreage. The awarding of concessions based on the bid response was expected to begin in early 1978.

No onshore drilling has been undertaken since Cía. Union Oil Co. of Honduras drilled in 1975. Early in 1977, prior to Decree 457, several companies received concession rights for petroleum exploration. Esso Standard Oil, S.A. Ltd. was granted four offshore blocks, and Anschutz de Honduras S.A. secured one onshore and one offshore block in addition to its one previously granted offshore block. Esso Standard agreed to operate the Anschutz concession and conducted an aeromagnetic survey. Signal Exploration and Development Co., Union Oil, and Phillips Petroleum Co. relinquished a total of 11.5 million acres of offshore permits during 1977.

The Governments of Honduras and Nicaragua continued their negotiations over an official boundary line between the two countries in the Caribbean Sea.

NICARAGUA[1]

The mineral industry remained a minor factor in the overall economy of Nicaragua, and aside from the major companies already established, there was little interest on the part of investors to initiate new projects. Production of gold, silver, lead, and zinc all decreased substantially from 1976 levels, a downward trend that has been evident for some 20 years.

Inflows of hot, underground water continued to present major problems at the Limón mine operated by Empresa Minera de El Setentrión, in which the Canadian company Noranda Mines Ltd. holds a 60.5% interest. Efforts were directed toward sinking a new shaft in an attempt to dewater the flooded areas, which unfortunately contain El Setentrión's higher grade ore (0.44 troy ounce of gold per ton). Until controls are established, the company remains restricted to working lower grade ores. In 1977, the company treated 132,000 tons of ore averaging 0.38 troy ounce of gold per ton. El Setentrión produces a finely disseminated ore that requires grinding to 200 mesh to yield 92% to 93% recovery.

Neptune Gold Mining Co., owned by ASARCO Incorporated(51.5%)and Rosario Resources (36.5%), produced silver, gold, lead, zinc, and copper from its mines in the Rio Pis Pis area. Vesubio, the company's major mine, suffered cave-ins during 1977, and the resultant lost ore and pillars decreased reserves by 167,535 tons. Reserves of sulfide ore, grading 0.8% lead, 5.76% zinc, 0.42% copper, 1.00 troy ounce of silver, and 0.099 troy ounce of gold per ton, were estimated at 882,019 tons at yearend. Gold ore reserves were estimated at 55,431 tons grading 0.397 troy ounce of gold per ton.

Rosario Mining of Nicaragua, wholly owned by Rosario Resources, continued underground development at the Riscos de Oro and Blag gold-silver mines near the old Rosita open pit copper mine in Zelaya Department, about 34 kilometers southeast of Neptune's operations. By yearend, about 520 meters of horizontal development had been completed at Riscos de Oro, and the shaft at Blag was deepened 98 meters; stoping was initiated at both mines. Estimates of ore reserves were reduced at both mines owing to unfavorable results from development work. Ore from all of Rosario's mines is milled at the Rosita mill, which was converted from a 1,800-ton-per-day copper flotation unit to a 450-ton-per-day cyanide mill, with a standby provision for base

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metal sulfide flotation. Introduction of surface ore from the La Luna open pit mine caused temporary operational problems at the mill, but by yearend, the plant reached 80% capacity. Rosario's proven and probable ore reserves at yearend totaled 166,229 tons grading 8.69 troy ounces of silver and 0.193 troy ounce of gold per ton. In 1977, Rosario milled a total of 73,174 tons of ore, producing 119,394 troy ounces of silver and 6,918 troy ounces of gold.

Some smaller gold-milling expansion projects were underway during 1977, by Minas de Cerro Dorado Ltd. at its Santa Rosa mine and by LeMans Resources at the La Libertad mine.

Nicaragua has an active geothermal power development program. Empresa Nacional de Luz y Fuerza (ENALUF), the national energy company, has drilled and capped 20 geothermal wells at the foot of the Momotombo Volcano located on the shore of Lake Managua. Bids have been requested for a 35-megawatt electric powerplant, with completion planned for the first half of 1980. Additional capacity is planned for 1981-82 if sufficient geothermal fluids are available.

No commercial petroleum or natural gas resources have been found in Nicaragua, although several companies were actively exploring offshore. Union Oil Co. of Central America initiated a three-well drilling program offshore near Puerto Cabezas. Occidental Petroleum Corp. spudded an offshore well near the Quita Sueño Bank, but no further information was made available. Texaco Caribbean Inc. assigned Amerada Hess of Nicaragua a 50% interest in its offshore exploration permits in the Punto Mico, Maiz Grande, and Maiz Pequeño areas. Texaco and Amerada Hess, in a joint venture, planned to drill in the Caribbean off the coast of southern Nicaragua in 1978. Rosario sought a partner to explore its 1.4-million-acre concession option in northeastern Nicaragua. Its 1976 seismic program indicated several favorable structural anomalies.

Table 8.—Nicaragua: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum metal including alloys, all forms	95	357	El Salvador 212; Honduras 81; Costa Rica 49.
Copper:			
Ore and concentrate	3,310	2	All to United States.
Metal including alloys, all forms	2	(1)	All to Costa Rica.
Iron and steel metal:			
Scrap	12	5	All to West Germany.
Semimanufactures	7,729	9,360	Guatemala 3,231; Costa Rica 2,801; El Salvador 1,920; Honduras 1,276.
Lead:			
Ore and concentrate	5,548	1,718	All to United States.
Metal including alloys, all forms	--	(1)	All to Costa Rica.
Silver metal, worked and partly worked troy ounces	142,460	120,179	Canada 107,158; United States 13,021.
Zinc:			
Ore and concentrate	15,571	21,571	United States 13,162; Belgium-Luxembourg 8,409.
Metal including alloys, all forms	39	--	
Other: Scrap and waste of nonferrous metals	382	247	West Germany 128; United States 77; Netherlands 30.
NONMETALS			
Abrasives, natural	(1)	--	
Asbestos	(1)	4	Mainly to El Salvador.
Clays and clay products:			
Crude	52	133	El Salvador 99; Panama 20.
Products:			
Refractory (including nonclay bricks)	3	15	All to Costa Rica.
Nonrefractory	2,814	4,357	Costa Rica 2,676; Honduras 679; Guatemala 575.
Diatomite	771	1,646	Honduras 1,218; Costa Rica 406.
Feldspar and related materials	222	467	All to Costa Rica.
Fertilizer materials:			
Crude, nitrogenous	--	(1)	Do.
Manufactured:			
Nitrogenous	318	1,262	Panama 1,004; Honduras 258.
Phosphatic	5	--	
Other including mixed	221	197	All to Honduras.
Gypsum and plasters	16,279	14,419	All to Costa Rica.

See footnotes at end of table.

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Table 8.—Nicaragua: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Lime	737	802	Costa Rica 776.
Salt	7,133	8,393	Costa Rica 8,254.
Sodium and potassium compounds, caustic soda	19,953	24,414	Guatemala 9,442; El Salvador 7,450; Costa Rica 4,871; Honduras 2,590.
Stone, sand and gravel:			
Dimension stone, crude and partly worked	218	339	Mainly to Costa Rica.
Other stone, industrial	62	40	Guatemala 20; Honduras 19.
Sand including ground quartz	46	--	
Talc and steatite, natural	7	27	United States 20; Costa Rica 7.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt, natural	40	--	
Hydrogen, helium, rare gases	(1)	--	
Petroleum refinery products:			
Kerosine—42-gallon barrels	9,308	26,203	Costa Rica 16,609; El Salvador 4,336; Guatemala 2,871.
Lubricants—do	76	129	Mainly to Costa Rica.
Other:			
Liquefied petroleum gas—do	7,030	14,167	Costa Rica 11,566; Honduras 2,601.
Pitch, resin, petroleum asphalt, petroleum coke, and other byproducts of coal and petroleum, n.e.s—do	106,264	95,688	Costa Rica 75,357; Honduras 19,548.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	1,772	1,148	Guatemala 627; El Salvador 429.

[1]Less than 1/2 unit.

Table 9.—Nicaragua: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum metal including alloys, all forms	1,360	1,400	United Kingdom 321; Canada 204; France 204; United States 177; El Salvador 169.
Copper:			
Ore and concentrate	--	--	
Copper sulfate	16	52	United States 45.
Metal including alloys, all forms	149	133	West Germany 69; United States 33.
Iron and steel metal:			
Ferroalloys	40	--	
Primary forms	10,544	5,148	Japan 5,132.
Scrap	6	1	Mainly from Costa Rica.
Semimanufactures	40,451	57,203	Japan 26,453; United States 6,742; Costa Rica 5,456.
Lead metal including alloys, all forms	170	276	United States 99; Mexico 72; Denmark 61.
Nickel metal including alloys, all forms	(1)	(1)	All from United States.
Silver metal, worked and partly worked—troy ounces	5,980	4,501	United States 3,762.
Tin metal including alloys, all forms	17	20	United Kingdom 9; Guatemala 4; Belgium-Luxembourg 3; United States 3.
Zinc metal including alloys, all forms	301	194	Mexico 115; United States 77.
Other:			
Ore and concentrate of base metals, n.e.s	(1)	1	Mainly from United States and West Germany.
Scrap of nonferrous metals	2	7	All from Honduras.
Base metals including alloys, all forms, n.e.s	11	8	All from United States.
NONMETALS			
Abrasives, natural, including industrial diamonds	274	220	Costa Rica 171; West Germany 16; United States 12.
Asbestos	1,207	1,560	Canada 1,057; U.S.S.R. 228; Australia 182.
Asphalt, natural	--	(1)	All from Costa Rica.
Boric acid	8	14	West Germany 8; France 4; Netherlands 2.
Cement	5,766	3,927	West Germany 2,716; Japan 1,175.
Clays and clay products:			
Crude	3,411	6,508	United States 4,983; United Kingdom 756.
Products:			
Refractory	773	750	United States 611; Costa Rica 108.
Nonrefractory	688	365	Italy 97; Costa Rica 86; United States 81; Guatemala 22.

See footnotes at end of table.

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Table 9.—Nicaragua: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Diatomite	750	239	United States 218; Mexico 20.
Feldspar and related materials	675	1,443	Guatemala 1,314; United States 128.
Fertilizer materials:			
Crude	1	1	All from West Germany.
Manufactured:			
Nitrogenous	59,299	32,000	United States 9,459; Romania 7,590; Netherlands 3,757; West Germany 3,095.
Phosphatic	7,577	7,750	United States 3,700; Costa Rica 3,008; West Germany 993.
Potassic	753	3,592	United States 2,678; Costa Rica 914.
Other including mixed	253	1,433	West Germany 536; Costa Rica 474; United States 331.
Graphite, natural	6	3	Mainly from United States.
Gypsum and plasters	284	408	United States 171; United Kingdom 121; Guatemala 49; Netherlands 36.
Lime	1,927	1,088	United Kingdom 635; West Germany 395.
Mica, worked, including splittings and waste	2	1	All from West Germany.
Pigments, mineral, natural	23	5	All from United States.
Precious and semiprecious stones, including diamond kilograms	5	177	Netherlands 141; Spain 32.
Salt	26,464	34,181	Chile 33,500.
Sodium and potassium compounds, n.e.s	3,719	793	United States 358; West Germany 263.
Stone, sand and gravel	385	561	Costa Rica 429; Guatemala 68.
Sulfur:			
Elemental	230	296	Mainly from West Germany.
Sulfuric acid	697	726	El Salvador 665; Guatemala 57.
Talc	179	378	United States 299; Japan 20.
Other crude nonmetallic minerals, n.e.s	1,179	99	Guatemala 61; United States 35.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	2	12	All from West Germany.
Coal, coke, peat	8	51	All from United States.
Hydrogen, helium, rare gases	--	1	Mainly from United States.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	r4,924	4,258	Mainly from Venezuela.
Refinery products:			
Gasoline do	97	127	Netherlands Antilles 101; Panama 16.
Kerosine do	17	17	United States 8; Panama 4; Netherlands Antilles 4.
Distillate fuel oil do	r230	183	Panama 122; United States 33; Netherlands Antilles 19.
Lubricants do	56	73	United States 30; El Salvador 15; Jamaica 14; Netherlands Antilles 13.
Other:			
Liquefied petroleum gas do	(1)	--	
Mineral jelly and wax do	5	10	West Germany 3; United States 2; Japan 2; Taiwan 2; France 1.
Pitch, resin, petroleum asphalt, petroleum coke, other coal and petroleum residues do	1	1	Mainly from United States.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	4,465	5,759	Netherlands Antilles 3,734; United States 1,851.

rRevised.
[1]Less than 1/2 unit.

PANAMA[3]

After the 0.6% growth in the real gross domestic product (GDP) in 1975 and the more discouraging zero growth in 1976, Panama's 1.6% growth in 1977 offered a small but welcome measure of encouragement, although it was still well below the Latin American average growth of 5%. The new Panama Canal Treaty and the estimated $65 million to $70 million in direct annual payments that will accrue after the treaty becomes effective in 1979 will enable Panama to negotiate greater international borrowing for development purposes. Active mineral production in Panama during 1977 was limited to salt, limestone, sand, gravel, cement, and clay.

Panama has been the site of the discovery of at least two significant copper deposits in the past 10 years. The location and geological setting of the Cerro Colorado, Petaquilla, and several smaller copper prospects were described by Kesler.[4] These copper

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deposits are the object of both Government and private engineering and financial feasibility studies and could play a major role in Panama's future mineral and economic development plans.

The Cerro Colorado deposit, with latest reserve estimates reporting the presence of 1.4 billion tons of ore grading 0.78% copper and 0.01% molybdenum and a total resource potential of up to 3 or 4 times this tonnage, is one of the largest undeveloped copper deposits in the world, surpassed possibly only by the huge Udokan deposit in the U.S.S.R. The deposit also contains an average of 0.003 troy ounces of gold and 0.16 troy ounce of silver per ton.

State-owned Corp. de Desarollo Minero Cerro Colorado, in which Texasgulf Inc., holds a 20% minority equity participation, was established to develop the Cerro Colorado deposit. Texasgulf is under contract to manage the feasibility study, design, construction, and operation of the project and was scheduled to complete the detailed evaluation study for the Government by May 1978. Panama is still seeking outside financial support to cover the cost of the project, estimated at $800 million to $1.2 billion.

Cerro Colorado infrastructure plans include a road, port facilities, and freshwater supplies. The open pit mine and adjacent concentrator would operate at a capacity of up to 27 million tons of ore per year, with smelter output calculated at 182,000 tons of blister copper per year. The smelter would be located at the port, approximately 63 kilometers from the mine. The study included a phosphoric acid plant to utilize sulfuric acid from the smelter operation. The plant would produce about 266,000 tons per year of phosphoric acid. Panama planned to construct a large dam and powerplant at La Fortuna to serve the Cerro Colorado operation.

Panama Copper Co., a subsidiary of Mitsubishi Metal Corp. (Japan), was evaluating its feasibility studies of the Petaquilla porphyry copper deposits, located in the Donoso District in the western part of Colón Province. It was estimated that the deposits contain as much as 300 million tons of ore averaging 0.7% copper.

To the west of Cerro Colorado, the Chorcha copper deposit was under study by Asarco; no details were available. Development of these Panamanian copper resources are dependent on both the availability of capital and the prospects of more favorable copper market conditions in the 1980's.

In September, a U.S. company, Northville Industries Corp., agreed to join the Government in the $47 million construction of a 2.5-million-barrel oil transshipment and storage terminal. The Panamanian Government acquired a 25% interest in the venture, called Petroterminal de Panama S.A., and granted Northville exclusive transshipment rights for 20 years. Alaskan crude oil in Very Large Cargo Carriers would be offloaded at Puerto Armuelles, stored, and reloaded into smaller tankers for transport through the Panama Canal to U.S. gulf coast and east coast refineries.

There was no petroleum exploratory drilling in Panama during 1977. Texaco Inc.'s subsidiary Panama Exploration Inc. expected to drill in 1978. The company signed a farmout agreement assigning 50% of its 1.2 million acres of offshore concession to Amerada Hess Corp. of Panama. The concession is located in the Golfo de los Mosquitos in the Caribbean. The Government would share in any production from development of the concession.

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[1]Prepared by Doris M. Hyde, physical scientist.

[2]U.S. Embassy, San Salvador, El Salvador. State Department Airgram A-09, Mar. 3, 1977, 2 pp.

[3]Prepared by George J. Coakley, physical scientist.

[4]Kesler, S.E., et al. Evolution of Porphyry Copper Mineralization in an Oceanic Island Arc: Panama. Econ. Geol., v. 72, 1977, pp. 1142-1158.

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The Mineral Industry of Other Areas of the Far East and South Asia

By Staff, Branch of Foreign Data

CONTENTS

	Page		Page
Bangladesh	1173	Mongolia	1187
Brunei	1178	Nepal	1188
Hong Kong	1179	Singapore	1189
Kampuchea, Democratic (formerly Cambodia)	1184	Sri Lanka	1198
Laos	1186	Vietnam	1202

BANGLADESH[1]

Mineral production was of little significance in the country's economy, and Bangladesh was not a world-ranked producer of any mineral commodity during 1977. Natural gas was the most important mineral exploited; however, reserves were sufficient to allow for much greater production.

Economically, Bangladesh made some progress in 1977-78[2] in its struggle against poverty, underdevelopment, and rapidly increasing population. The gross domestic product (GDP) grew 8%, mainly owing to a 13% increase in food grain production, the key economic indicator in this highly agricultural nation. GDP at current prices dropped slightly in Fiscal Year (FY) 1976-77 to $6.6 billion[3] and rose to $7.2 billion in FY 1977-78. The population rose from 81 million in FY 1975-76 to about 85 million in FY 1977-78, resulting in an increase of per capita GDP from $83 to $85 during the same period. The high annual population growth rate, over 3% in 1976 and about 2.8% in 1977, was recognized by the Government as the main problem facing the country. Average density was 525 people per square kilometer. A similar density would have the entire world population living within the continental United States.

Exports rose from $381 million in FY 1975-76 to $422 million in FY 1976-77 and to $497 million in FY 1977-78. Minerals played virtually no part in export revenue, with jute, jute products, and tea accounting for nearly all of the value. Imports dropped from $1,265 million in FY 1975-76 to $865 million in FY 1976-77, but increased again in 1977-78 to $1,274 million.[4] Imports were mostly raw materials, industrial goods, and food grains. Most of the $775 million trade gap has to be met with foreign aid, which continued to be a basic weakness of Bangladesh's economy. Prudent fiscal policies have kept inflation between 10% and 15% during the last 2 years. Private domestic and foreign investment grew satisfactorily in FY 1977-78 because of favorable government policies, but the amount remained small compared to the need.

On the negative side, rural and urban

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poverty have increased drastically since the 1960's, and over one-half of all families are malnourished in terms of minimum calorie intake. Per capita food production and the gross national product (GNP) have not recovered to 1970 levels. Approximately 38% of the labor force of 29 million was unemployed or underemployed, and the number of job seekers was growing twice as fast as new jobs were created.[5]

The Government's policy was actively encouraging new industries in the less developed and nonmetropolitan areas. Import duties and taxes were cut significantly, a higher debt-equity ratio was allowed, and lower electric power and transportation costs were offered. Small-sized and agro-based industries were particularly welcome. Further development in the metropolitan areas of Dacca, Chittagong, and Khulna was restricted by zoning and financial disincentives.[6]

Natural gas was the only significant mineral commodity produced in Bangladesh during 1977. Production during the year was just under 1 billion cubic meters (100 million cubic feet per day). Utilization of natural gas in Bangladesh was low compared with many other countries. Total proved reserves of seven fields were reported to be at least 235 billion cubic meters. The ratio of current production to reserves was about 0.004. This ratio for India and Pakistan is more than 3.3 times larger; for Brunei, 6.6 times larger; and for industrialized West Germany, nearly 20 times larger. It was estimated that just the present proved fields could support a production of eight times the current rate.

There have been discussions with several countries on the possibility of increasing utilization by setting up an export-oriented liquefied natural gas (LNG) plant at Chittagong using the reserves found at the Bakhrahad discovery, southeast of Dacca. However, there were no firm projects in the offing at the end of 1977. Because of the extreme cost involved, and the possible environmental considerations in several prospective client countries, the outlook for the construction of the plant must be considered as a very long-term possibility.

The domestic breakdown of gas utilization in 1977 was as follows: Production of fertilizer, 48%; electric power, 36%; cement, 4%; other industries, 9%; and commercial and domestic usage, 3%.

Petroleum exploration in the offshore areas met with mixed success during the year. Drilling offshore 96 kilometers southwest of Chittagong in shallow water, Union Oil Co. of Bangladesh struck natural gas at about 2,670 meters. The well, designated Kutubdia No. 1, tested 500,000 cubic meters per day of good quality dry gas.

The Yugoslav offshore exploration firm INA-Naftaplin and its partner Texas Pacific Oil Co., Inc., drilled the only other hole during the 1977 drilling season. The hole lost drilling fluids at 4,267 meters and drilling was terminated well above the target formation. A production test was made at the 3,660-meter level but it showed nothing and the hole was plugged and abandoned. Last year, extreme pressure at about the 4,200-meter level forced abandonment of INA's first hole in this same concession area.

Bengal Oil Development Co. of Japan was scheduled to begin drilling a deep test offshore early in 1978. By yearend 1977, four of the six companies that once held offshore drilling contracts (Atlantic Richfield Co., Ashland Oil Co., INA-Naftaplin, and Superior Oil Co. of Canada) had terminated their contracts. Onshore, production testing was done on the 1976 gas discoveries at Hijla-Muladi No. 1 and Begumganj No. 1. The results of the testing were not certain.

Bangladesh has found no crude oil in the country and continued to be dependent on petroleum imports for much of its energy needs. Crude oil imports for FY 1976-77 were 1.1 million tons, all of which came from Abu Dhabi or Iran. It was refined in the country's only refinery, at Chittagong. An additional 225,000 tons of various petroleum products were also imported from a variety of countries.

Other than natural gas production, the mineral industry contributed very little to the Bangladesh economy, but several projects were planned that would add to the country's mineral output. Cement production was 323,000 tons in 1977, a 40% increase over the 230,000 tons produced in 1976. This was produced by the Chhatak cement plant, which used local raw materials, and the new Chittagong clinker grinding plant, which used imported clinker. Implementation of an ambitious plan for cement self-sufficiency was delayed for lack of financing. The plan envisioned a limestone mine and clinker production plant to be set up at Jaipurhat in the Bogra district. The clinker plant would supply 1,000 tons per day to the Chittagong plant and 1,000 tons per day to a proposed grinding plant at Khulna. The final stage would be an additional 1,000 tons per day cement plant at Jaipurhat. Completion of the project would meet all of Bangladesh's domestic cement

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requirements for several years.

A large occurrence of granite gneiss rock suitable for all types of construction work was identified at Ranipukur near Madhyapara in the Dinajpur district. The Government was interested in developing a 1.7-million-ton-per-year quarry at the deposit and was trying to arrange financing for the project. Bangladesh's construction sector is a large potential market for hard-rock building materials. Its present needs are supplied by high-priced brick or rock from riverine boulder deposits at Bholaganj in the Sylhet district.

A white clay mine was under development in Bijaipur. The project produced a small amount of clay during the construction period. Output was scheduled to be 3,500 tons per year when the mine goes onstream.

Work begun in 1976 continued on the Ashuganj nitrogenous fertilizer plant. Problems with site preparation caused delays early in 1977, but construction continued satisfactorily at yearend. The plant will produce 925 tons per day of ammonia and 1,600 tons per day of urea, and use natural gas as feedstock and fuel. The plant is sited on the Meghna River, about 64 kilometers northeast of Dacca.

Bangladesh currently uses natural gas to produce nitrogenous fertilizers from plants in Ghrashal and Fenchuganj, which have a combined capacity of 191,000 tons per year nitrogen content. Technicians from Mainland China were conducting a feasibility study during the year for building a small nitrogenous fertilizer plant at Ghorashal, adjacent to the existing one.

Plans were made for the construction of a large ammonia/urea plant at Chittagong. The plant would require a pipeline from the undeveloped Bakhrabad gas discovery near Dacca. This plant would be set up instead of the more expensive and controversial LNG plant. As in the cement industry, financing of the project will be a major consideration in whether it becomes a reality.

Table 1.—Other Areas of the Far East and South Asia: Production of mineral commodities

Area,[1] commodity, and unit of measure	1975	1976	1977[p]
BANGLADESH[2]			
Cement, hydraulic — metric tons	[r]169,274	230,339	322,697
Clays (china clay) — do.	3,384	1,575	[3]4,211
Fertilizer materials:[4]			
Nitrogenous:			
Gross weight:			
Urea — do.	69,091	279,922	285,612
Ammonium sulfate — do.	4,928	5,802	9,260
N content[5] — do.	32,700	131,100	[e]130,400
Phosphatic: Triple superphosphate, gross weight — do.	32,856	48,963	47,980
Gas, natural, marketed production[6] — million cubic feet	33,000	31,344	32,026
Iron and steel:			
Crude steel (ingots only) — metric tons	[7]97,151	82,227	116,259
Mild steel products — do.	[7]77,509	80,285	128,863
Petroleum refinery products:			
Gasoline — thousand 42-gallon barrels	373	468	491
Jet fuel — do.	124	166	60
Kerosine — do.	1,258	1,985	2,021
Distillate fuel oil — do.	895	1,306	1,317
Residual fuel oil — do.	2,026	3,000	3,031
Lubricants — do.	--	207	209
Other:			
Naphtha — do.	429	831	832
Unspecified — do.	208	9	
Refinery fuel and losses — do.	459	458	375
Total — do.	5,772	8,430	8,336
Salt, marine — metric tons	[r]746,523	557,919	557,919
Stone, limestone, industrial — do.	70,176	60,800	56,300
BRUNEI[2]			
Gas, natural:			
Gross production — million cubic feet	268,390	341,343	346,011
Marketed production — do.	[r]214,394	298,829	314,253
Natural gas liquids:			
Condensate — thousand 42-gallon barrels	2,566	4,031	3,062
Natural gasoline — do.	397	573	816
Liquefied petroleum gas — do.	143	144	166
Total — do.	3,106	4,748	4,044

See footnotes at end of table.

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Table 1.—Other Areas of the Far East and South Asia: Production of mineral commodities —Continued

Area,[1] commodity, and unit of measure	1975	1976	1977[p]
BRUNEI[2] —Continued			
Petroleum:			
Crude—thousand 42-gallon barrels	65,932	74,424	76,650
Refinery products:			
Gasoline—do	160	153	141
Distillate fuel oil—do	221	209	219
Residual fuel oil—do	1	1	1
Other—do	40	32	32
Refinery fuel and losses—do	1	1	1
Total—do	423	396	394
HONG KONG[2]			
Cement, hydraulic—thousand metric tons	575	765	1,029
Clays, kaolin—metric tons	1,490	1,305	2,466
Feldspar—do	2,059	2,299	3,378
Iron ore and concentrate, gross weight—do	167,200	37,058	--
Quartz—do	761	982	2,063
KAMPUCHEA, DEMOCRATIC[2]			
Cement, hydraulic[e]—do	50,000	50,000	50,000
Gold, mine output, metal content[e]—troy ounces	500	1,000	1,000
Salt[e]—metric tons	30,000	30,000	30,000
LAOS[2]			
Salt, rock[e]—do	10,000	10,000	10,000
Tin, mine output, metal content—do	518	[e]576	[e]600
MONGOLIA[2]			
Cement, hydraulic—thousand metric tons	159	[e]160	[e]160
Coal:			
Anthracite and bituminous—do	[r]171	205	[e]240
Lignite and brown—do	[r]2,555	2,716	3,078
Total—do	[r]2,726	2,921	3,318
Fluorspar, all grades[e]—do	302	302	320
Gypsum[e]—do	25	25	28
Lime, quicklime and hydrated[e]—do	40	40	50
Petroleum refinery products:			
Kerosine[e]—thousand 42-gallon barrels	23	16	NA
Residual fuel oil[e]—do	20	13	NA
Total of listed figures[e]—do	43	29	NA
Salt[e]—metric tons	11,000	11,000	15,000
SINGAPORE[2]			
Cement, hydraulic[e]—thousand metric tons	1,320	1,350	1,350
Iron and steel, crude steel—do	187	200	[e]200
Petroleum refinery products:			
Gasoline—thousand 42-gallon barrels	18,111	11,985	13,152
Jet fuel—do	19,460	24,022	21,194
Kerosine—do	5,587	10,244	21,173
Distillate fuel oil—do	37,112	43,479	51,189
Residual fuel oil—do	39,956	52,341	69,436
Lubricants—do	2,118	3,001	3,278
Other—do	11,683	21,896	28,110
Refinery fuel and losses—do	5,048	5,635	9,086
Total—do	139,075	172,603	216,618
Stone, granite, broken—thousand cubic meters	2,302	2,524	2,572
Sulfur, byproduct from oil refinery—metric tons	[e]6,000	[e]7,000	23,043
SRI LANKA			
Cement, hydraulic—thousand metric tons	393	426	356
Clays:			
Ball—metric tons	1,423	796	1,590
Kaolin—do	[r]3,698	4,360	5,182
Brick and tile clay—do	127,692	51,014	132,621
Clay for cement—do	60,090	57,307	34,617
Feldspar, crude and ground—metric tons	1,270	3,199	3,679
Gem stones, precious and semiprecious, except diamond—value, thousands	[r]$26,801	$33,946	$28,828
Graphite, all grades—metric tons	11,982	8,290	8,875
Mica, scrap—do	[r]2,464	137	[e]100
Petroleum refinery products:			
Gasoline—thousand 42-gallon barrels	746	846	858

See footnotes at end of table.

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Table 1.—Other Areas of the Far East and South Asia: Production of mineral commodities —Continued

Area,[1] commodity, and unit of measure	1975	1976	1977[p]
SRI LANKA —Continued			
Petroleum refinery products —Continued			
Jet fuel — thousand 42-gallon barrels	439	615	580
Kerosine — do.	1,610	1,460	1,423
Distillate fuel oil — do.	2,702	2,719	2,722
Residual fuel oil — do.	3,580	3,421	3,608
Other — do.	1,068	1,095	1,071
Refinery fuel and losses — do.	746	664	651
Total — do.	10,891	10,820	10,913
Rare-earth minerals, monazite concentrate, gross weight — metric tons	7	1	[e]5
Salt — do.	120,967	140,504	51,923
Sand and gravel, glass sand — do.	NA	1,240	NA
Steel, semimanufactures — do.	21,243	28,295	[e]28,000
Stone:			
Dolomite — do.	3,136	NA	NA
Limestone — thousand metric tons	714	647	566
Quartz, massive — metric tons	296	838	768
Titanium:			
Ilmenite concentrate, gross weight — do.	64,010	55,814	34,092
Rutile concentrate, gross weight — do.	3,111	1,039	978
Zirconium concentrate, zircon, gross weight — do.	39	10	[e]10
VIETNAM[e 8]			
Cement, hydraulic — thousand metric tons	700	[r]700	700
Chromite — metric tons	NA	[r]9,000	15,000
Clay, kaolin — do.	1,000	1,000	1,000
Coal, anthracite — thousand metric tons	4,000	5,000	6,100
Fertilizer materials, crude phosphatic, phosphate rock — do.	1,400	1,500	1,500
Gypsum — metric tons	7,000	[r]10,000	12,000
Salt — thousand metric tons	[r]350	[r]350	375
Iron and steel:			
Primary, ingot — do.	200	200	200
Semimanufactures, rolled — do.	20	20	20
Tin:			
Mine output — metric tons	250	250	250
Smelter output[9] — do.	200	200	200
Zinc:			
Mine output, metal content — do.	10,000	10,000	10,000
Smelter output, primary — do.	5,000	10,000	10,000

[e]Estimated. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the countries listed individually in this table, Nepal, covered textually in this chapter, presumably produces a variety of crude construction materials such as clays, stone, and sand and gravel, and may produce cement, but production statistics are not available and general information is inadequate to make reliable estimates of output levels.

[2]In addition to the commodities listed, a variety of crude construction materials such as clays, stone, and sand and gravel presumably were produced, but production statistics are not available and general information is inadequate to make reliable estimates of output levels.

[3]May include other clays.

[4]Data for years ending June 30 of that stated.

[5]As reported by United Nations.

[6]Gross production not reported; the quantity vented, flared, or reinjected is believed to be negligible.

[7]Revised from zero.

[8]In addition to the commodities listed, iron ore and lead-zinc ores were mined in the past, and the country produced pig iron, crude steel, and smelter zinc from its industrial facilities, but the status of these industries under prevailing conditions is not sufficiently clear to permit preparation of reliable estimates of output. Similarly, no data on crude construction materials are available and no reliable basis for estimation is available.

[9]Based on import statistics of the U.S.S.R. and Japan.

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BRUNEI[7]

Brunei was one of the world's largest exporters of LNG and an important South Asia exporter of crude oil in 1977. There was no other commercially important production of mineral commodities in the country.

The year ending December 1977 was one of unprecedented prosperity for Brunei owing to its oil and natural gas production. Exchange rate fluctuations, which had caused problems in recent years, were less noticeable in 1977 because overseas investments had been diversified and changes in currency rates were not so dramatic as in past years.

The gross domestic product increased nearly 12% to an estimated $1.65 billion.[8 9] The country reportedly earned nearly $900 million in 1977 and expected the figure to rise to over $1,000 million in 1978. Government earnings were derived mainly from royalties, dividends, and taxes from the production of oil and natural gas. A small amount of income was derived from the sale of rubber and timber. Recurring Government expenditures were anticipated at $385 million in 1978 and an additional $69 million was to be put aside for development projects. The Government thus stood to have a sizable surplus in 1977 and probably again in 1978. It was reported that the treasury had an accumulated revenue fund surplus of over $2.13 billion at the end of 1977.[10]

During the year, the Government increased its holdings in the Brunei Liquefied Natural Gas Co., Ltd. (BLNG), from 10% to 33-1/3%. Brunei Shell Petroleum Co. Ltd., Mitsubishi Co., and the Brunei Government each holds one-third interest in the plant.

The Brunei Government planned to diversify the economy by developing industries other than oil and gas. Possible alternatives are a wood pulp and paper plant or an oil palm plantation, both still in the planning stages.

A project by the Government to provide modern health services for the people got underway in mid-year. It was the construction of a large well-equipped hospital complex, estimated to cost about $32 million in 1977. The final cost, however, may be over $42 million.

COMMODITY REVIEW

Petroleum and Natural Gas.—Crude oil production averaged about 213,000 barrels per day during 1977. Virtually all production was exported because domestic consumption was insignificant. Brunei Shell Petroleum Co. and its equal partner, the Brunei Government, produced petroleum from four offshore fields and one onshore (Seria) during 1977. Southwest Ampa field was the largest producer, with about 92,000 barrels per day. Total amount of crude produced in 1977 was nearly 77 million barrels (10.4 million tons) valued at about $1.1 billion. Production was 3% more than in 1976, but its respective current value was 16% more because of world price increases for crude oil.

The 56-kilometer oil pipeline from the Seria oilfield to the loading port at Lutong across the border in Malaysia was formally closed. Exports are now handled by local loading equipment at Seria.

A modest amount of drilling took place during the year, mostly development work at old fields and at small new offshore discoveries. It was reported that some deep onshore wells would be drilled in 1978. The drilling program was designed to develop enough new production potential to maintain present production levels. Output at Seria will probably begin to taper off soon, since the field has produced almost continuously for the past 50 years. Seria produced over 860 million barrels of oil (116 million tons) during that period.

The Brunei LNG Co. Ltd. facility, located on the coast at Lumut, was the largest fully operational LNG plant in the world. The final liquefaction line was completed in mid-1976 and the plant has operated at more than its 5-million-ton-per-year design capacity since then.[11]

Gross natural gas production was 9.8 billion cubic meters in 1977. Marketed gas totaled 7.6 billion cubic meters, a 5% increase over that of 1976. The gas was processed through the BLNG plant and exported 5.3 million tons in special 75,000-cubic-meter-capacity tankers. The entire output, valued at an estimated $588 million, went by contract to Japan.

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HONG KONG[12]

Hong Kong's GDP in 1977 was estimated at US$5.6 billion in constant 1966 prices, compared with $5.1 billion in 1976.[13] Services accounted for 44.0% of the GDP in 1977, followed by manufacturing, 25.0%; agriculture, 1.6%; mining, 0.1%; and other, 29.3%. The British Crown Colony relies almost wholly on foreign raw materials to meet the needs of its population and the requirements of its industries and service-oriented businesses. Aside from tourism, light industries dominate the local economy, which is dependent on sales and shipments of export goods. Production of textiles and clothing, electronic articles, plastic products, watches and clocks, and other consumer articles account for over 76% of the value of the Colony's total domestic export. Moreover, over 69% of the total industrial work force is employed in these sectors.

Because of increasing competition from export-oriented countries in the region, Hong Kong's industries continued to modernize operations and to move into more sophisticated product lines. On March 1, 1977, the Hong Kong Industrial Estates Corp. was established by statute to plan industrial development, minimizing land-use conflicts. By yearend, 15 hectares of land became available for subleasing at the Tai Po Industrial Estate; when completed in 1980, the total area will be 45 hectares. Other estates were planned for Yuen Long, Tsing Yi, and Kwai Chung. Five special industry projects were granted land in Tsing Yi: A machinery plant, textile auxiliary chemical production, and three shipyard projects. At Kwai Chung, land was made available for container maintenance and repairing service; also, applications for chloralkali manufacture, industrial gas production, and food processing were under consideration.

Mainland China ranks after Japan as Hong Kong's major supplier for imports. In 1977, total imports from China amounted to $1.7 billion. While Hong Kong has been a prime outlet for Chinese goods, it was expected that the Colony would assume an even more important role. At yearend 1977, China was estimated to have $2 billion worth of investments in Hong Kong. Far East Overseas Oil Co. Ltd. has about a 2.4-million-barrel storage capacity for Chinese oil as well as tanker port facilities in Hong Kong. Because of its location and logistic advantage, the Colony could be the regional headquarters for the development and marketing of Chinese oil as well as a center for exporting technology to China.

China Light and Power of Hong Kong was negotiating the purchase of power equipment for construction of a coal-fired powerplant in the New Territories. China was expected to supply up to 3.5 million tons per year of coal by the late 1980's in return for electricity exported to Kwangtung.

PRODUCTION

Minerals mined and produced in Hong Kong included beryl, feldspar, graphite, iron ore, kaolin, quartz, cassiterite, and wolframite. By 1977, mine production in the Colony was limited to feldspar, kaolin, and quartz. The New Territories Mining Co., Ltd., which operated the Ma On Shan iron ore mine, suspended operations in April 1976 owing to low-grade ore and the depressed world market for iron and steel.

At yearend, the total land area covered by prospecting and mining licenses and mining leases totaled about 397 square kilometers: There were two prospecting licenses (kaolin and quartz); eight mining licenses (feldspar, kaolin, and quartz); and three mining leases (feldspar, iron ore, quartz, and wolframite). Revenues from mining, prospecting fees, and royalties were $9,280 in 1977 compared with $64,135 in 1976. The number of mines extant in 1977 included three for feldspar, one for iron ore (inactive), six for kaolin, and four for quartz. No fatalities were reported for the mining and quarrying sector during the year; however, 124 injuries resulted from accidents, of which 8 were in mining and 116 in rock quarry operations.

TRADE

Hong Kong's total two-way trade was $20.2 billion in 1977, composed as follows: $10.5 for imports, $7.7 for domestic exports, and $2.1 for reexports. The Colony's major trading partners were the United States ($4.4 billion), Japan ($3.1 billion), Mainland China ($1.7 billion), and the United Kingdom and Federal Republic of Germany ($1.1 billion each). Major mineral-related imports included mineral fuels and lubricants ($648 million); nonmetallic mineral manufactures ($711 million); and iron and steel ($296 million), compared with domestic exports of metalliferous ores and metal scrap ($35 million); nonmetallic mineral manufactures

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($51 million); iron and steel ($4 million); and manufactures of metal ($215 million).

Exports of kaolin to Japan and Taiwan in 1977 totaled 3,120 tons, valued at $109,244; exports of feldspar to Japan, Philippines, and Taiwan were 1,183 tons valued at $55,067. Iron ore shipments were all to Japan in 1976 and totaled 51,361 tons valued at $619,777. During 1977, Hong Kong imported 2,973 tons of quartz, 3,975 tons of feldspar, 1,344 tons of graphite, and 22,612 tons of kaolin clay.

COMMODITY REVIEW

Metals.—*Iron Ore.*—The Ma On Shan mine at Tide Cove opened in May 26, 1931. Iron ore and some wolframite were produced from this 640-acre mine site. In April 1976, the New Territories Mining Co., Ltd., suspended operations at the mine because of the depressed world market for iron and steel. However, at yearend, 40 persons were reportedly still employed by the company, which holds a mining license valid until 1981.

Tungsten.—Yan Hing Mining Co., Ltd., was holder of a mining lease issued on May 9, 1957, and valid for 21 years, for the Needle Hill tungsten mine, covering 540 acres. Mining was suspended at the end of 1967 because of the low market price of tungsten ore and the rising cost of skilled labor. Subsequently, Yan Hing's holding was reduced to 288 acres following the surrender of land to the Hong Kong Government for construction of the lower Shing Nun Reservoir in 1961. In 1977, Yan Hing completed a feasibility study on reopening the mine; the study concluded that Needle Hill was workable for 15 years, provided the price of tungsten ore remained steady. The company has applied to the Land Officer for a renewal of its mining lease to reopen Needle Hill.

Nonmetals.—*Feldspar.*—During 1977, 3,378 tons of feldspar was produced by the Hong Kong Clays and Kaolin Co., Ltd. mine at Cha Kwo Ling, which covers 19 acres. Mine output also included some kaolin. Previously, feldspar was produced at Tung Lo Wan (Sha Tin) and at Needle Hill. During 1977, 1,183 tons of feldspar was exported to Japan, the Philippines, and Taiwan; 1,179 tons was shipped for local sale; and 3,975 tons was imported.

Kaolin.—In 1977, kaolin mine production totaled 2,466 tons: 3,120 tons was exported to Japan and Taiwan; 378 tons was shipped for local sales; and 22,612 tons was imported for consumption. In addition to the feldspar (and kaolin) operation at Cha Kwo Ling, there were five kaolin mining licenses in force during 1977 covering 25.2 acres: Two at Pillar Point, Castle Peak (5.8 acres); two on Tsing Yi Island (6.7 acres); and one at Deep Bay, Yuen Long (12.7 acres). During 1977, one prospecting license, issued on July 10, 1975, was in effect for kaolin prospecting on 7.2 acres on Chek Lap Kok Island.

Aggregates.—Consumption of aggregates (predominantly quartz) runs 7 to 8 million tons per year in addition to about 1 million tons of sand dredged from marine sediments. Cha Kwo Ling Quarry is the largest in the Colony and has an output capacity in excess of 1.5 million tons per year. Shek O Quarry, operated by the Pioneer Group of Australia, has an output of about 1 million tons per year. Other large quarries include Diamond Hill and Kwo Ling, the former supplying all the bituminous materials required by the Colony's Highway Department.

Table 2.—Hong Kong: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Bauxite and concentrate	13,014	10,435	Taiwan 7,529; Thailand 2,319.
Oxide and hydroxide	222	814	Vietnam 500; Indonesia 301.
Metal including alloys, all forms	r13,438	17,460	Japan 5,415; Taiwan 2,476.
Arsenic trioxide, pentoxide, acids	55	17	Vietnam 9; Indonesia 5.
Chromium oxide and hydroxide	65	20	Indonesia 18.
Cobalt oxide and hydroxide	(1)	5	Taiwan 3; Philippines 1.
Copper:			
Oxide and hydroxide	2	4	Malaysia 3.
Metal including alloys, all forms	5,757	8,660	Japan 6,039; United States 1,525.

See footnotes at end of table.

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Table 2.—Hong Kong: Exports and reexports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Gold metal, unworked or partly worked thousand troy ounces	1,975	396	Taiwan 336.
Iron and steel:			
Ore and concentrate thousand tons	164	56	All to Japan.
Scrap do	159	177	Taiwan 77; Japan 60.
Pig iron, steel ingot, similar material do	1	1	Mainly to Taiwan and Indonesia.
Semimanufactures do	16	29	Macau 7; Indonesia 5.
Lead:			
Oxide	1	9	Thailand 8.
Metal including alloys, all forms	1,395	2,140	Taiwan 1,842.
Magnesium metal including alloys, all forms	4	26	Japan 14; United States 12.
Manganese oxide	49	186	Vietnam 92; Indonesia 75.
Nickel:			
Oxide and hydroxide	5	7	Taiwan 6.
Metal including alloys, all forms	114	302	Japan 181; Republic of Korea 114.
Silver metal including alloys thousand troy ounces	2,833	946	United Kingdom 500; France 202; Switzerland 189.
Tin metal including alloys, all forms	531	608	Taiwan 246; Singapore 163.
Titanium oxide	340	587	Taiwan 305; Philippines 92; Thailand 77.
Tungsten metal including alloys, all forms	12	1	Mainly to United Kingdom.
Zinc:			
Oxide	38	175	Vietnam 140; Macau 17.
Metal including alloys, all forms	541	625	Philippines 378; Singapore 111; Thailand 84.
Other:			
Oxides, hydroxides, peroxides of metal, n.e.s	16	16	Japan 13.
Metals including alloys, all forms:			
Metalloids	(1)	(1)	All to Nigeria.
Base metals including alloys, all forms	45	7	Indonesia 5; Canada 1.
NONMETALS			
Abrasives:			
Natural, n.e.s	29	54	Burma 17; Kampuchea 17; Taiwan 10.
Grinding and polishing wheels and stones	397	359	Nigeria 108; Indonesia 84.
Asbestos	50	433	Thailand 300; Republic of Korea 133.
Barite and witherite	22	611	Taiwan 600.
Cement, hydraulic	2,816	3,462	Macau 2,193.
Clays and clay products, including all refractory brick:			
Crude, n.e.s	20,968	25,974	Taiwan 23,957.
Products value, thousands	$930	$804	Nigeria $174; Indonesia $158; Macau $132.
Cryolite and chiolite	--	--	
Diamond:			
Gem not set or strung thousand carats	335	443	Japan 97; Israel 84; United States 80.
Industrial value, thousands	$42	$36	Australia $30.
Diatomaceous earth	15	11	India 7.
Feldspar and fluorspar	161	1,666	Taiwan 1,030; Philippines 237; Thailand 234.
Fertilizer materials:			
Crude	43	89	Singapore 77.
Manufactured	5	5	Mainly to Malaysia.
Ammonia	(1)	(1)	All to Indonesia.
Graphite	2,559	1,886	United States 1,696.
Gypsum and plasters	286	456	Indonesia 421.
Lime	85	125	Macau 71.
Mica, all forms	28	38	Taiwan 18; Republic of Korea 17.
Pigments, mineral, including processed iron oxide	127	186	Vietnam 92; Indonesia 75.
Precious and semiprecious stones, including synthetic, other than diamond value, thousands	r$96,358	$116,940	Japan $64,107; United States $23,217.
Salt and brine	10	108	Malaysia 105.
Sodium and potassium compounds, n.e.s.	4,137	3,783	Philippines 2,902; Indonesia 500.
Stone, sand and gravel:			
Dimension stone	2,210	3,068	Indonesia 1,072; Taiwan 832.
Gravel and crushed rock	45	50	All to Taiwan.
Quartz and quartzite	470	705	Thailand 500; Ivory Coast 91.

See footnotes at end of table.

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Table 2.—Hong Kong: Exports and reexports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Sulfur:			
Elemental, all forms	238	32	Macau 18; Singapore 6.
Sulfuric acid	7	51	Kampuchea 47.
Talc, steatite, soapstone, pyrophyllite	226	2,422	Indonesia 1,460; Vietnam 500.
Other nonmetals, n.e.s.:			
Crude	306	205	Taiwan 100; Nigeria 100.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	3	141	Nigeria 60; Macau 48.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black and gas carbon	32	285	Kampuchea 175; Singapore 58.
Coal and coke, including briquets	576	43	Macau 38.
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	58	53	All to Macau.
Kerosine do	29	28	Macau 25.
Distillate fuel oil do	448	562	All to Macau.
Residual fuel oil do	57	54	Do.
Lubricants do	138	192	Taiwan 51; Indonesia 20.
Mineral jelly and wax do	23	8	Indonesia 4; Madagascar 3.
Other do	26	28	Macau 25.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	2	12	Malaysia 4; Philippines 3; Thailand 3.

[r]Revised.
[1]Less than 1/2 unit.

Table 3.—Hong Kong: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite and concentrate	9,349	4,789	All from China, mainland.
Oxide and hydroxide	483	1,091	China, mainland, 815; West Germany 155.
Metal including alloys, all forms	30,744	32,684	Japan 5,553; Canada 4,760; Australia 4,504.
Arsenic trioxides, pentoxides, acids	40	46	China, mainland, 36; West Germany 5.
Chromium oxide and hydroxide	3	10	Japan 6; West Germany 3.
Cobalt oxide	36	56	United Kingdom 41; Belgium-Luxembourg 6.
Copper:			
Copper sulfate	87	90	United Kingdom 87.
Oxides and hydroxides	91	134	West Germany 64; Norway 41; Japan 17.
Metal including alloys, all forms	23,699	25,884	Japan 20,019.
Gold metal, unworked and partly worked thousand troy ounces	697	3,750	Switzerland 1,813; United Kingdom 1,385; Australia 386.
Iron and steel:			
Scrap thousand tons	49	122	Australia 52; Taiwan 25; Singapore 12.
Pig iron, ferroalloys, similar materials do	19	20	Japan 2; Taiwan 1.
Steel, primary forms do	74	71	Australia 35; India 24; Japan 11.
Semimanufactures do	430	807	Japan 544; Taiwan 38; United Kingdom 35.
Lead:			
Oxides, n.e.s	90	210	Australia 115.
Metal including alloys, all forms	707	1,679	Canada 590; Vietnam 320.
Magnesium metal including alloys, all forms	--	9	United Kingdom 7.
Manganese:			
Ore and concentrate	620	547	Thailand 540.
Oxides	1,053	2,059	Japan 1,171; China, mainland, 330; United States 246.
Mercury 76-pound flasks	929	2,723	China, mainland, 2,058; U.S.S.R. 375.

See footnotes at end of table.

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Table 3.—Hong Kong: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Nickel:			
Oxides	48	95	Canada 63; United Kingdom 18.
Metal including alloys, all forms	352	798	Canada 537; Finland 119.
Platinum-group metals including alloys, all forms thousand troy ounces	186	278	Japan 132; West Germany 50; United Kingdom 29.
Rare-earth oxides	4	3	France 2.
Silver metal including alloys, all forms thousand troy ounces	1,383	782	Philippines 396; United Kingdom 113; Australia 108.
Tin metal including alloys, all forms	637	1,072	Malaysia 837; China, mainland, 134.
Titanium:			
Ore and concentrate	90	60	All from Australia.
Oxides	2,256	3,833	Japan 789; United Kingdom 636; West Germany 570.
Tungsten metal including alloys, all forms	141	2	United States 1.
Zinc:			
Oxides	514	915	West Germany 203; France 191; China, mainland, 145.
Metals including alloys, all forms	24	175	Japan 46; United Kingdom 21.
Other:			
Oxides, hydroxides, peroxides of metal, n.e.s	24	12	Japan 6; Taiwan 3; China, mainland, 3.
Metals including alloys, all forms:			
Metalloids	35	7	Japan 6.
Base metals including alloys, all forms	63	98	Austria 43; China, mainland, 31.
NONMETALS			
Abrasives:			
Natural, n.e.s	376	608	Japan 290; United States 222.
Dust and powder of precious stones value	$14,402	$27,508	Belgium $18,823; United Kingdom $5,589.
Grinding and polishing wheels and stones	968	1,824	China, mainland, 689; United Kingdom 286.
Asbestos	907	851	China, mainland, 561; Republic of South Africa 260.
Barite and witherite	198	1,013	China, mainland, 940.
Boric acids	204	148	United States 131.
Cement, hydraulic thousand tons	1,153	3,149	Republic of Korea 546; China, mainland, 456; Japan 251.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s	13,118	17,682	China, mainland, 7,617; United States 6,067.
Products value, thousands	$15,072	$17,588	China, mainland $6,533; Japan $4,855; Italy $2,673.
Cryolite and chiolite	10	9	All from Denmark.
Diamond:			
Gem thousand carats	1,005	1,228	Israel 357; India 291; Belgium-Luxembourg 201.
Industrial value, thousands	$63	$127	Singapore $73; Belgium-Luxembourg $25; Switzerland $22.
Diatomaceous earth	142	199	United States 188.
Feldspar and fluorspar	1,910	2,312	China, mainland, 2,261.
Fertilizer materials:			
Crude	643	963	Thailand 635; China, mainland, 290.
Manufactured:			
Nitrogenous	2,836	2,683	Japan 2,189.
Phosphatic	71	27	All from United States.
Potassic	--	1	Do.
Other, including mixed	6,268	9,353	West Germany 7,852; France 1,075.
Ammonia	412	657	Japan 559.
Graphite	2,890	2,171	China, mainland, 1,939.
Gypsum and plasters	25,542	25,657	Japan 11,140; Mexico 10,349.
Lime	34,885	40,313	China, mainland, 28,543; Taiwan 8,767.
Magnesite	679	1,368	China, mainland, 1,048; Japan 320.
Mica, all forms	128	174	Japan 101; India 55.
Pigments, mineral, including processed iron oxides	192	584	China, mainland, 275; United Kingdom 94; West Germany 85.

See footnotes at end of table.

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Table 3.—Hong Kong: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Precious and semiprecious stones, including synthetic, other than diamond value, thousands	$50,339	$68,577	Australia $14,498; Sri Lanka $10,773; Switzerland $5,767.
Salt	42,162	54,306	China, mainland, 25,782; India 10,915; Taiwan 6,609.
Sodium and potassium compounds, n.e.s	22,598	24,004	China, mainland, 6,822; United States 4,397; Taiwan 3,856.
Stone, sand and gravel:			
Dimension stone	8,572	6,714	Italy 4,977; China, mainland, 1,649.
Gravel and crushed rock	227,780	149,203	Macau 138,577; China, mainland, 10,049.
Limestone, except dimension	6,154	7,460	All from China, mainland.
Quartz and quartzite	1,387	2,090	China, mainland, 2,007.
Sand, excluding metal-bearing	900,212	517,265	China, mainland, 517,209.
Sulfur:			
Elemental, all forms	2,012	2,018	Japan 1,269; Singapore 295; West Germany 277.
Sulfuric acid	1,611	1,855	Taiwan 1,588.
Talc and related material	1,353	4,037	China, mainland, 3,685.
Other nonmetals, n.e.s.:			
Crude	5,124	5,231	China, mainland, 5,035.
Mineral waste	1,796	2,397	China, mainland, 1,289; Singapore 508.
Oxides, hydroxides, peroxides of magnesium, strontium, barium	7	3	United States 2.
Fluorine, bromine, iodine	(1)	(1)	Mainly from Japan.
Building materials of asphalt, asbestos, and fiber materials, and unfired nonmetals	14,487	16,777	United Kingdom 8,405; China, mainland, 2,868.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	16	104	All from United Kingdom.
Carbon black and gas carbon	489	819	Japan 314; United States 185; Australia 178.
Coal, coke, peat including briquets	14,346	13,627	Vietnam 5,977; China, mainland, 5,640.
Petroleum and refinery products:			
Gasoline including natural thousand 42-gallon barrels	984	1,143	Singapore 751; Republic of Korea 283.
Kerosine, aviation, industrial and white spirit do	6,111	6,835	Singapore 4,135; China, mainland, 1,083; Republic of Korea 987.
Diesel and distillate fuel oil do	6,612	8,258	Singapore 4,491; China, mainland, 2,384; Republic of Korea 685.
Residual fuel oil do	18,162	21,820	Singapore 14,632; Kuwait 1,706.
Lubricants do	271	449	Singapore 119; China, mainland, 102; Australia 83.
Mineral jelly and wax do	51	69	China, mainland, 53; Singapore 10.
Other:			
Bitumen and other mixtures do	128	98	Singapore 80; Republic of Korea 14.
Liquefied petroleum gas do	875	578	Singapore 369.
Pitch do	326	(1)	All from United Kingdom.
Unspecified do	89	(1)	Mainly from Singapore.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	35	69	United Kingdom 45; Japan 21.

[1]Less than 1/2 unit.

DEMOCRATIC KAMPUCHEA[14]

Output by the mineral industry contributed very little to Kampuchea's[15] largely agrarian economy in 1977. Kampuchea was not ranked as an important world producer of any mineral. A variety of minerals might be developed given a thorough exploration effort using modern geophysical and geochemical surveying techniques. The only significant minerals that have been produced were phosphate rock, gems, salt, and nonmetallic construction materials for cement, brick, and tile manufacture. No mineral production figures were available for the year.

Bauxite was known to occur in commercial quantity, but development plans were at a standstill. In addition, deposits of copper ore, coal, gold, iron ore, and manganese ore reportedly have been identified.

Economic data for Kampuchea were scarce. The latest estimate for gross national product was $590 million in 1975. Limited

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exports to Hong Kong resumed in 1976. In 1977, Hong Kong, Singapore, and Japan began purchasing small amounts of agricultural products from Kampuchea, probably totaling collectively less than $1 million in value. Imports from these same countries increased from about $2.5 million in 1976 to around $19 million in 1977. Imports consisted mostly of pharmaceuticals, insecticides, textile yarns, petroleum products, machinery, and replacement and spare parts.

It was also presumed that Mainland China and possibly some other countries provided assistance by furnishing machinery and spare parts, steel semimanufactures, foodstuffs, fertilizer, and farm materials.

Irrigation and water conservation projects received high priority during the year in an effort to maximize rice production. During the 1977 dry season, reservoirs and canals were reportedly completed with an aggregate capacity of 2.8 billion cubic meters. A total of at least 250,000 hectares of land was brought under year-round irrigation during the year.

Fighting erupted at yearend along the southeastern border between Kampuchean and Vietnamese troops. The plans for developing industry and for increased mineral exploration and exploitation undoubtedly were seriously disrupted because of the conflict.

COMMODITY REVIEW

Brick was produced from local clay minerals at several locations. No large plants were known to be operating during the year. A small plant at Phumi Prek Reang (probably 11°39' N, 104°53' E) in Kampong Spoe Province began operating at the end of 1975 and produced brick, roofing tiles, and a variety of earthenware containers. Production was to double in 1978. Other plants were being repaired and still others built around the country.

A glassware factory resumed operation at Boeng Cheung Ek (coordinates unknown) southwest of Phnom Penh in July 1977. The plant used local raw materials and was repairing a 6-ton and a 15-ton furnace to increase production of glass containers.

Kampuchea produces salt for domestic consumption from seawater evaporation. During the first 6 months of 1977, workers reportedly exceeded the quota by 70%.

Japan's first mineral-related trade contract with Kampuchea since the change of government in April 1975 was reportedly signed in February 1977. A Japanese company was to export 10,000 tons of rolled steel to Kampuchea. There were no integrated steel smelters in Kampuchea. However, crude iron foundries were operating at Phumi Srov Leu (10°42' N, 104°29' E), Phumi Trapeang Veng, Phum Chrak Kes, and in several other locations. These were locally made, batch-fired, charcoal-fueled furnaces. The charge consisted of various types of steel or iron scrap, additives, and some locally produced iron ore. While production was only on the order of 1-2 tons per firing, the product was reported to be a good grade of malleable iron. These smelters turned out plowshares and other agricultural tools, pots, pans, water pump parts, tools, metal fasteners, and replacement parts for a wide range of equipment.

The most important mineral commodity to the Kampuchean economy is currently phosphate rock, mined mainly at Tuk Méas (10°40' N, 104°34' E). Phnom Penh radio indicated that production increased during the year as ore-pulverizing equipment was repaired and improvised using any suitable material or device. The plant was relocated from near the city to the edge of the quarry to save on ore transportation costs. Production resumed in 1976 after the plant had been damaged in 1970. The plant was originally able to produce 12,000 tons per year (P_2O_5 content) of phosphate rock. While production is unknown, it is unlikely to have been more than a few thousand tons in 1977.[16]

In June 1977, a new phosphate fertilizer factory started operating at O Prasat commune in the Mongkól Borei district (13°28' N, 103°10' E). The plant had one rock crushing unit and seven pulverizing machines and reportedly was turning out 12 to 15 tons per day of fertilizer. If this production figure is correct, the plant would supply some of the needs of the northwest provinces and eliminate transportation costs from Tuk Méas.

Kampuchea produced no crude oil or natural gas during 1977, nor was there any known exploration conducted either onshore or offshore. The old French 12,000-barrel-per-day petroleum refinery at Kompong Som (10°38' N, 103°30' E) was damaged during the Civil War. It was not repaired during 1977 and the country's petroleum needs were satisfied by imports of finished petroleum products. The value of Kampuchea's petroleum imports from Hong Kong and Singapore reportedly rose to over $3 million in 1977.

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LAOS[17]

During the second year of the new regime's operation, the People's Democratic Republic of Laos continued the struggle to become economically viable. A combination of devastating drought throughout much of the country and the absence of foreign aid upon which it has traditionally been dependent left Laos with little financial stability. Thailand controlled goods carried to and from Laos with blockade actions, which further affected the economy. The Government exchanged the old currency for the new liberation kip (K) in 1976 in an attempt to stop inflation. The inflation continued, however, despite the effort. At the time of exchange in June 1976, the U.S. dollar was worth K200. By the beginning of 1977, it had risen to K1,400 and, during the year, it rose to a high of K2,200 per U.S. dollar.[18] The GNP at market prices was estimated to be $257 million in 1977.

The Government's basic objective of attaining self-sufficiency in food production by 1980 received a serious setback in 1977. Owing to severe drought, the national rice harvest was 40% less than that of the preceding year, with some areas of the country as much as 95% less. Some effort was made to transplant seedlings to parts of the country less affected but with only limited success. A joint study by the United Nations Development Program with the Laos Agricultural Ministry stated that there would be widespread famine in the country if external aid were not permitted in the form of edible rice, seeds, and pesticides.

Another major goal of the new Government was the construction, improvement, and repair of the nation's roadways. Work went forward on these projects during 1977, with more than 500 kilometers of roads and 16 bridges being completed or restored. The roads between Laos and Vietnam remained poor. Plans for a new road and bridge link between Thailand and Laos were apparently dropped.

The hydroelectric station at Nam Ngum continued with phase 2 of its building program; expansion was scheduled to be completed sometime in mid-1978. Nearly one-half of the power from this plant was exported to Thailand during 1977. This mutually beneficial power-sharing arrangement has continued for years, despite the changing political conditions between the two countries. When the increased capacity (from 30 megawatts to 110 megawatts) is realized, new opportunities could develop in the mineral industry. The electric power grid will be extended into the more remote agricultural communities. Some marginal mineral deposits could be developed in these areas where power was not previously available. The Government announced that total electric power output in 1977 rose 10%. Electric power output for domestic use in 1978 was expected to increase 16% over that of 1977, and total electric power output in 1978 was planned to reach 340 million kilowatt-hours.

COMMODITY REVIEW

The major foreign exchange earner for Laos has been the country's tin mining operations, with concentrates being shipped to Thailand and Malaysia for smelting. During the second half of 1977, the Laotian Government nationalized without compensation the French-owned Phon Tiou tin mine, operated and partly owned by Société D'Etudes et d'Exploitations Miniéres de l'Indochine. Because of the complicated technology involved in concentrating the 0.2% Sn ore, the Laotians will need technical assistance in the operation of this mine. It is believed that Soviet experts will be used in management, but the maintenance and supplying of spare and replacement parts will be a major problem since the machinery is of United States, British, and French manufacture. It is doubtful, therefore, whether production can be continued at the current level of 900 to 1,000 tons per year of concentrate. Despite the maintenance situation, the Government's 1978 plan called for an increase in production of "refined tin" of about 900 tons.[19] It was not clear what this referred to since there was no known tin smelter in Laos.

The total output of salt from the Ban Keun area (18°22' N, 102°35' E) of the Vientiane Province rose from 3,000 tons the previous year to 7,000 tons during 1977. This amount meets the needs of both the Province and Vientiane City as well as providing a large quantity of salt for transporting to other provinces. The plan for the next year was to increase salt production to 15,000 tons, with most of the increase coming from the Vientiane Province. Additional small saltworks will contribute the balance of the quota.

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The rich potash deposits along the Mekong River remained undeveloped owing to the lack of economic and technical resources needed to begin exploitation. The U.S.-surveyed sylvite deposit was 3.5 meters thick and encountered at depths of between 94 and 432 meters. The deposit could provide a valuable source of fertilizer, both for domestic use and for export to neighboring potash-deficient countries.

Rich iron ore deposits reportedly occur in Xiangkhoang Province (18°30' N, 103°30' E), but there was no decision on developing them because of the large amounts of capital that would be needed.

Laos continued to import modest amounts of petroleum products from Thailand since there was no crude oil or natural gas produced in the country during 1977.

Coal was mined near Muang Vangviang (probably 18°56' N, 102°27' E). Quality of the coal was good but production was apparently only a few thousand tons per year. There are also known occurrences of coal in the Saravane Province.

MONGOLIA[20]

The economy of the Mongolian People's Republic traditionally has been based on agriculture. Animal and agricultural products accounted for about one-half of Mongolia's output and almost 90% of the country's exports. In 1976, Mongolia initiated its sixth 5-year plan by which the country would be transformed to an industrial-agrarian-based economy. The plan called for closer integration of Mongolian and Soviet economies under the direction of the Mongolian-Soviet Intergovernmental Commission for Economic, Scientific, and Technological Cooperation.

The plan stressed higher labor efficiency and better product quality, and set a target of a 62.9% increase in gross industrial production over the 5-year period. As a basis for industrialization, much emphasis was to be placed on (1) developing the mining industry, particularly by coal, copper, fluorspar, and molybdenum, and (2) geological surveying for potential mineral deposits for commercial exploitation.

Mongolia continued to be dependent on foreign assistance. Government revenue in 1977 was estimated at 3,312 million tugriks compared to Government expenditure of 3,300 million tugriks. Mongolia exports mainly raw materials and foods (estimated value of imports in 1975 was $213 million) but imports value-added goods, such as machinery and plant equipment, manufactured consumer products, and petroleum. Exports in 1975 were valued at an estimated $260 million. The principal source of outside financial assistance was the U.S.S.R. and the Council for Mutual Economic Assistance (CMEA).[21]

Capital investment in 1978 for industrial expansion was projected to be $507 million, largely for the copper and molybdenum development at Erdenet. The 220-kilowatt powerline from Gusinoozersk in the U.S.S.R. to the industrial combine was completed in 1976, and the power station's first generator began operating. Construction of a water pipeline from the Selanga River was completed, measuring 80 centimeters in diameter and running 64 kilometers. In 1977, passenger train service was opened, linking Erdenet with Darhan and Ulan Bator. A radio relay line was put into operation between Erdenet and Dashinchilen, construction of a 265-meter bridge was completed across the Selanga River.

About 300,000 tons of fluorspar is produced annually from the Berhin fluorite mine. Reconstruction of the mine was well underway and, reportedly, construction of another similar enterprise was to begin in 1978 in the area of Berhin. Construction of the fluorite mine at Boro Ondor in southeastern Mongolia, described as the country's largest fluorite mine, began in 1977 with Soviet assistance. By the end of the current economic plan, export of fluorspar was expected to be 2.1 times the current level.

Coal mining is Mongolia's foremost mineral industry. During 1977, production of lignite and brown coal was estimated at 3.1 million tons and anthracite and bituminous coal, at 240,000 tons. About 75% of the country's coal output came from open pit mines, with the bulk of the production from Nalayha, Sharyn Gol, and Chuluum. Construction was to begin in 1978 on a large open pit coal mine at Baga Nuur, located about 110 kilometers southeast of Ulaanbaatar. This mine scheduled to open in 1980, was to be one of the largest coal mining enterprises in the state, producing 2 million tons per year of coal. A new city was to be built along the bank of the Hulen River, containing housing for 20,000 people.

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NEPAL[22]

Nepal is not a major producer of any mineral commodity and the mining sector accounts for under 0.2% of the GDP. Agriculture accounts for about two-thirds of the GDP and directly employs 85% of the work force. Farming throughout most of the country is strictly on a local subsistence level.

The country did not have a good economic year in either FY 1976-77 or in FY 1977-78.[23] The GDP at constant 1975 prices was estimated at $1.49 billion[24] for both years and was up only marginally from the $1.44 billion recorded in FY 1975-76. The modest gain in GDP was more than offset by the 2.5% annual population growth. In addition, the price stability which prevailed the previous 2 years disappeared with an inflation rate of over 11% in FY 1977-78.

Nepal's trade imbalance, which had also remained relatively constant over the past 2 years, increased sharply from $70 million to $121 million in FY 1977-78. Exports decreased from $97 million in FY 1976-77 to $85 million in FY 1977-78. In the same period, the value of imports rose from $167 million to $206 million. Over 47% of the exports went to India and 63% of the imports came from India.

The Government, with considerable assistance from a variety of aid donors, continued to devote the major portion of its resources to developmental activities. The most important achievements to date have been in the area of infrastructure—roads, power, communications, and airfields. Over 50 kilometers of paved roads and 250 kilometers of motorable roads were added to the country's existing network during 1977. Opening of hitherto inaccessible areas to motor vehicles will help facilitate mineral exploration efforts. Three new small airfields also were completed and the national airline added a second jet to its fleet. Toward the end of the year, the Government's emphasis in spending was redirected from infrastructure development to the areas of health care, education, and agriculture.

Electric power demand has been increasing in the Kathmandu Valley and shortages were developing. In order to alleviate the situation, the Asia Development Bank financed the 32-megawatt Kulekhani hydroelectric project, under construction 30 kilometers southwest of the capital. This will be the largest powerplant in the country when completed in 3 or 4 years. Other power projects are planned or underway for later completion.

COMMODITY REVIEW

Cement was the most important mineral-based industry in the country; its value accounted for about 95% of the total of minerals produced in 1977. Production from the only plant was over 42,000 tons in FY 1976-77 and 28,000 tons in the first 9 months of FY 1977-78. The 50,000-ton-per-year designed capacity of the Himal plant, completed in 1975, did not meet the demand, which was estimated at 160,000 to 170,000 tons per year. The difference was made up by imports from India and several other countries. In order to relieve the shortages, the Government-owned Hetauda Cement Industries, Ltd., began construction of a 260,000-ton-per-year plant at Hetauda. The town is strategically located at the juncture of the Katmandu Valley, the Birgunj-Hetauda industrial corridor, and the head of the Chitawan Valley. The plant will employ about 1,400 persons and is being financed by a loan from the Asian Development Bank. Scheduled completion is for November 1981.

There have been discussions with Indian officials on the feasibility of jointly establishing a large, export-oriented cement plant in the Udaipur district southeast of Katmandu, where over 25 million tons of high-grade limestone have been confirmed.

The first lime plant in Nepal was inaugurated in December 1977 at Chobhar in the Katmandu area. The plant capacity was rated at 6,000 tons per year of agricultural lime. Nepal reportedly consumes a great deal more than this, presumably all imported from India.

Demand for limestone has increased with the growing number of industries in the country. Nepal became self-sufficient in FY 1975-76 and produced about 54,000 tons of limestone in FY 1976-77. Most of the stone was quarried at Jogimara, and Birgunj. Plans were underway to increase production by at least 4,000 tons in 1978.

The Nepal Mining Co. in 1976 began development of the Ganesh Himal zinc mine at Lari, 56 kilometers northwest of Katmandu. There were no recent data available on the project but it was assumed that shaft sinking was continuing. This would be the first metallic mineral exploitation in Nepal by a modern operation.

Mainland China was reportedly aiding in the construction of a 20-million-unit-per-

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year brick and tile works at Nangkhel in Bhaktapur. The plant was scheduled for opening in late 1979.

A small but encouraging copper deposit was discovered in 1977 by the Mining and Geology Department in the Baglung district (approximately 28°16' N, 83°36' E), 180 kilometers west of Katmandu. Apparently, about 150,000 tons of ore were assayed showing 1.7% copper and 1.5 grams per ton of gold. Unless additional tonnage is discovered, this one deposit would not appear to be economically exploitable.

In addition, Nepal has been studying deposits of iron ore, magnesite, and coal, which may be large enough to develop. The Mines and Geology Department, in conjunction with an Indian company, were studying the feasibility of establishing a small steel plant based on an iron ore deposit at Phulchoki near Katmandu. Presently, a small foundry and rolling mill turn out about 5,000 tons per year of reinforcing bars and structural shapes. More sophisticated varieties and forms of steel are imported.

Discussions were underway with India on the possibility of setting up a magnesite refractory brick plant at Lamosangu or Birgunj. The magnesite deposit is reportedly located at Kharidhunga in Sindu Palchok district (27°55' N, 85°45' E). The products would be exported to India.

The Nepalese press announced the discovery of a coal deposit in the Mekwanpur district only 11 kilometers from the Hetauda industrial area. Further studies were underway to evaluate the deposit, which was discovered during the construction of the Hetauda-Narayanghat road. If developed, this would be the first bituminous coal mine in the country. Less than 2,000 tons of lignite were mined in Nepal in 1977.

Nepal was totally dependent on imports to supply its petroleum needs. The U.S.S.R. was a major supplier of petroleum through a swap arrangement with India. India took control of the incoming oil at various ports of entry and supplied an equal amount to Nepal from the refinery most convenient to the Nepal border. In FY 1976-77, Nepal received a total of about 75,000 tons of petroleum, mostly from the U.S.S.R. In FY 1977-78, the Soviet deliveries were reportedly about 51,000 tons, while other countries supplied about 77,000 tons. The total for FY 1978-79 was projected at about 140,000 tons.[25] It was evident that as Nepal's development efforts accelerate, its consumption of petroleum products will increase rapidly, putting a further burden on its already unfavorable balance of trade.

SINGAPORE[26]

Singapore with nearly 2.4 million people achieved a 9.7% economic growth rate, with the GNP in 1977 reaching an estimated $6.5 billion (or 15.5 billion Singapore dollars) in current prices.[27] Real growth rate was closer to 7.8%, which was the general level that government planners expected for 1977. Once one of Asia's star performers, the Singapore economy was entering a phase of consolidation and slower growth compared with that of the late 1960's and early 1970's, although it was still much above the average for most developing countries. The slowdown began with the international oil crisis. The prolonged slump in several leading industries, such as petroleum refining, oil rig construction, shipping, and shipbuilding, which was partly caused by the sluggish economies of Japan, Western Europe, and the United States, appeared to be ending in early 1977.

Entrepôt trade was still the dominant part of Singapore's economy in 1977, with services (including the hotel and restaurant trade) accounting for about 70% of its GNP and total foreign trade amounting to nearly three times the GNP. However, petroleum-related activities, advanced technology in manufacturing industries, and financial and communications activities have steadily gained ground. Manufacturing rose 8% in 1977, accounting for about one-fifth of the GNP. Two-thirds of the manufacturing output was exported. Combined foreign and domestic plant and equipment investment for Singapore was about $1 billion in both 1976 and 1977.

The petroleum industry was by far Singapore's most important "manufacturing" component, accounting for over 40% of its total manufacturing output in 1977 and about 15% of the value added in manufacturing. Oil refineries were upgrading their processing facilities, and the projected Sumitomo petrochemical complex, if actually started, would certainly provide some stimulus to the industry. Since Singapore is Southeast Asia's oil exploration support center, business was somewhat slow because of the relative inactivity in this area during the year.

The electrical and electronics industries increased output by 17%, despite growing

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restrictions in Singapore's traditional markets. Singapore maintained its competitive edge by making better and more various products. Three-quarters of all new manufacturing jobs were in the electronics industry. The clothing industry and the machinery-appliances sector remained sluggish in 1977.

Shipbuilding activities continued to decline because of the world surplus tonnage in ships. However, shipyards turned to building cranes, barges, dredges, and heavy offshore structures, as well as a few jackup rigs. Ship-repairing activity increased 10%. Singapore has been the world's No. 4 port for some years.

Alongside the progress in industry, trade, and tourism, Singapore made headway toward becoming a major international financial center through development of its Asian dollar market, gold market, and secondary money market. A gold exchange was created, involving both spot and future contracts based upon certificates of gold deposits issued by authorized banks, on similar lines as the Winnepeg exchange. With regard to trade, Singapore's foreign reserve position improved from $3.37 billion at yearend 1976 to $3.72 billion at yearend 1977.

PRODUCTION

In 1977, Singapore produced about S$7.02 billion (convert at the rate of S$2.42 to US$1) worth of petroleum products by processing S$6.25 billion worth of crude oil with roughly 3,100 workers, thereby earning S$774 million in value added.[28] In 1976, corresponding output was S$6.17 billion (convert at S$2.45 to US$1), input was S$5.50 billion, and value added was S$672 million. Residual fuel oil ranked first in production tonnage, followed by distillate fuel oil, gasoline, jet fuel, kerosine, and lubricants, in that order. The refining industry had not recovered from the loss of the Vietnamese market and reluctance of Japan to buy its refined oil. However, refining capacity utilization increased to over 60% in 1977. Singapore had been producing over 2.5 million cubic yards of granite annually in recent years. The country's mineral production statistics are shown in table 1 which covers all lesser countries in the Far East.

Singapore's mineral economy shows a pattern of processing foreign raw materials (and/or intermediate materials) and domestic scrap into finished products. More than 1 million tons of cement was produced for the sixth year in a row to sustain continued high levels of construction, but the principal raw material was actually imported clinker. The roughly 200,000 tons of ingot steel produced in 1977 was from scrap; Singapore also imported much larger tonnages of steel products and semimanufactures, some of which was converted to additional downstream products. The country's statistics show that value added for cement in 1977 was S$47 million; concrete products, S$25 million; iron and steel, S$66 million; nonferrous metals, S$13 million; and nonmetallic minerals, about S$38 million.

TRADE

Singapore's total foreign trade increased to S$45.6 billion (US$18.9 billion) in 1977, compared with S$38.7 billion (US$15.8 billion) in 1976. Exports (f.o.b.) rose 22% to S$20.1 billion and imports (c.i.f.) rose 19% to S$25.5 billion in 1977. The trade deficit was more than offset by income from services such as tourism, banking, insurance, shipping, and by capital inflow from abroad. In fact, a net balance-of-payments surplus of $404 million was registered in 1977. The preceeding figures do not include trade with Indonesia.

Singapore's most important trading partner in 1977 was the United States, with imports at S$3.23 billion and exports at S$3.12 billion, 12% and 15%, respectively, of the totals. Imports from Japan were higher at S$4.47 billion and exports to Japan lower at S$1.92 billion. Next came Peninsula Malaysia with imports of S$3.05 billion and exports of S$2.19 billion. Other important trading areas included Hong Kong, the United Kingdom, Australia, West Germany, Sabah-Sarawak, Thailand, the People's Republic of China, France, the Netherlands, and Italy.

In terms of commodity groups, Singapore's most important exports in 1977 were machinery and equipment, 24.5%; mineral fuels, 24.24%; crude inedible materials, 15.7; manufactured materials, 8.0%; food and live animals, 7.0%; and chemicals, 3.6%. The most important imports in 1977 were machinery and equipment, 26.4%; mineral fuels, 25.6%; manufactured materials, 14.2%; crude inedible materials, 8.9%; food and live animals, 8.7%; and chemicals, 5.2%.

The entrepôt nature of Singapore's economy is self evident in these trade figures and petroleum occupies a special position. In 1977, Singapore imported 23.6 million tons of crude oil and 4.0 million tons of refined oil, and exported 14.5 million tons of refined oil. Most of Singapore's crude oil imports

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came from Kuwait, Saudi Arabia, and Iran. Its sales of refined oil went primarily to other Asian countries or for bunkering, in addition to the domestic market. Singapore's 1977 oil import bill was about $2.69 billion, but its refined oil exports were worth $2.03 billion and monies earned from bunkering were sizable also.

Table 4.—Singapore: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum:			
Bauxite and concentrate	450	--	
Oxide and hydroxide	4,319	22,856	Malaysia 21,853.
Metal including alloys:			
Scrap	2,512	3,792	Japan 2,240; Pakistan 1,512.
Unwrought and semimanufactures	732	1,654	Malaysia 920; Thailand 335; Hong Kong 225.
Chromium oxide and hydroxide	16	13	Mainly to Malaysia.
Cobalt oxide and hydroxide	1	1	Mainly to Hong Kong.
Copper:			
Sulfate	183	165	Mainly to Malaysia.
Metal including alloys:			
Scrap	4,471	7,193	India 1,916; Republic of Korea 1,615; Malaysia 1,565; Pakistan 763.
Unwrought and semimanufactures	r1,802	1,637	Malaysia 1,561.
Iron and steel:			
Metal:			
Scrap	1,539	3,102	Taiwan 1,502; Japan 697; Netherlands 401.
Pig iron, ferroalloys, similar materials	7,702	5,213	Malaysia 5,182.
Steel, primary forms	8,448	5,765	Malaysia 5,326.
Semimanufactures:			
Bars, rods, angles, shapes, sections	55,848	55,412	Malaysia 35,865; Brunei 7,958.
Universals, plates, sheets	41,631	66,113	Malaysia 59,527.
Hoop and strip	1,161	2,216	Malaysia 2,178.
Rails and accessories	2,081	4,857	Malaysia 4,840.
Wire	2,785	3,393	Malaysia 2,134; Brunei 715.
Tubes, pipes, fittings	74,484	53,910	Brunei 13,353; United Arab Emirates 8,192; Malaysia 7,162.
Casting	762	175	Malaysia 95; Brunei 32.
Total	178,752	186,076	
Lead:			
Ore and concentrate	21	15	All to Malaysia.
Oxides	51	46	Malaysia 40; Hong Kong 6.
Metal including alloys:			
Scrap	627	1,561	Malaysia 867; Australia 318; Taiwan 231.
Unwrought and semimanufactures	646	511	Malaysia 424; Republic of Korea 30.
Manganese:			
Ore and concentrate	2,808	6,356	Malaysia 2,007; Kenya 1,029; Sudan 835; Philippines 698.
Oxides	61	539	Thailand 250; Malaysia 158; Taiwan 125.
Mercury 76-pound flasks	13	119	Netherlands 101; Malaysia 16.
Nickel metal:			
Scrap	255	205	Japan 189.
Unwrought and semimanufactures	r34	32	Malaysia 31.
Platinum-group metals and silver:			
Waste and sweepings kilograms	721	3,547	Japan 2,868; United Kingdom 601.
Metals including alloys:			
Platinum group thousand troy ounces	r85	(1)	Mainly to Malaysia.
Silver do	75	3	Brunei 1; Japan 1; Malaysia 1.
Thorium ore and concentrate kilograms	1,414	--	
Tin:			
Ore and concentrate	2,343	5,498	Spain 2,266; U.S.S.R. 1,173; Brazil 759; Mexico 691.
Metal including alloys:			
Scrap	71	73	United Kingdom 31; Denmark 22; Hong Kong 17.
Unwrought and semimanufactures	596	2,138	Hong Kong 263; Malaysia 208.
Titanium:			
Ore and concentrate	7	5	All to Canada.
Oxides	416	638	Malaysia 510; Republic of Korea 126.

See footnotes at end of table.

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Table 4.—Singapore: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS —Continued			
Tungsten:			
Ore and concentrate	13	159	Japan 105; West Germany 25; India 20.
Metal including alloys, all forms	246	65	United States 56; Malaysia 6.
Zinc:			
Ore and concentrate value, thousands	r$17	$1	All to Malaysia.
Oxides and peroxide, (except hydroxide)	110	616	Malaysia 301; Australia 141; Hong Kong 139.
Metal including alloys:			
Scrap and blue powder	287	621	Pakistan 409; Japan 139.
Unwrought and semimanufactures	2,202	2,920	Malaysia 2,539; Thailand 315.
Other:			
Ore and concentrate of base metals, n.e.s. (excluding iron and magnesium)	3	14	All to Malaysia.
Ash and residue containing nonferrous metals	4,717	5,978	Hong Kong 2,189; United Arab Emirates 1,842; Taiwan 623.
Oxides, hydroxides, peroxides of metals, n.e.s	r34	73	Malaysia 71.
Metals including alloys, all forms:			
Scrap, nonferrous	(2)	--	
Metalloids	35	32	Mainly to Malaysia.
Alkali, alkaline earth, rare-earth metals	15	2	Do.
Base metals including alloys, all forms, n.e.s	1,251	211	Japan 98; Malaysia 75.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	63	53	Malaysia 31; Pakistan 21.
Grinding and polishing wheels and stones	155	197	Malaysia 102; Hong Kong 61.
Asbestos	1,670	1,098	Malaysia 787.
Clays and clay products (including all refractory brick):			
Crude clays:			
Kaolin	144	611	Japan 360; Malaysia 251.
Other	11,837	10,629	Philippines 2,194; United Arab Emirates 2,014; Malaysia 1,902; Bangladesh 1,121.
Products:			
Refractory (including nonclay brick)	1,372	620	Malaysia 582.
Nonrefractory[3]	4,529	4,426	Malaysia 2,554; Brunei 1,330.
Diamond:			
Gem, not set or strung value, thousands	$8,186	$2,228	Hong Kong $1,573; Japan $298.
Industrial do	--	$73	All to Hong Kong.
Feldspar and fluorspar	1,529	5,105	All to Malaysia.
Fertilizer materials:			
Crude:			
Nitrogenous	2	8	Do.
Phosphatic	33,467	30,986	Malaysia 28,443.
Manufactured:			
Nitrogenous	21,845	27,830	Malaysia 27,788.
Phosphatic	6,324	2,230	Malaysia 2,173.
Potassic	134,740	153,045	Malaysia 146,579.
Other, including mixed	17,623	23,797	Malaysia 23,586.
Ammonia	336	383	Malaysia 368.
Graphite, natural	130	20	India 10; Malaysia 10.
Gypsum and plasters	357	610	Malaysia 519.
Lime	2,375	2,776	Malaysia 1,427; Brunei 982; Bangladesh 314.
Magnesite	58	182	All to Malaysia.
Mica, all forms	314	153	Bangladesh 41; Sri Lanka 37; Thailand 35.
Pigments, mineral:			
Natural, crude	69	24	Mainly to Malaysia.
Iron oxides, processed	102	108	Do.
Precious and semiprecious stones, including synthetic, except diamond value, thousands	$1,124	$3,124	Hong Kong $2,522; Japan $353.
Salt	12,408	11,996	Malaysia 5,950; Brunei 4,536.
Sodium and potassium compounds, n.e.s	7,938	4,771	Malaysia 4,405.

See footnotes at end of table.

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Table 4.—Singapore: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
NONMETALS —Continued			
Stone, sand and gravel:			
Dimension stone	1,961	732	Malaysia 493; Bangladesh 130; Brunei 94.
Dolomite, chiefly refractory grade	--	3	All to Malaysia.
Gravel and crushed rock	18,241	7,281	Brunei 6,444; Malaysia 770.
Limestone	212	294	Malaysia 264; Brunei 29.
Quartz and quartzite	2	--	
Sand, excluding metal bearing	1,179	1,346	Brunei 692; Malaysia 507.
Sulfur:			
Elemental:			
Other than colloidal	15,541	14,110	Mainly to Malaysia.
Colloidal	5,394	8,158	Malaysia 6,035; Thailand 900.
Sulfur dioxide	1	2	All to Malaysia.
Sulfuric acid	1,505	3,750	Malaysia 2,517; United Arab Emirates 910.
Talc, steatite, soapstone, pyrophyllite	807	1,156	Malaysia 1,123.
Other nonmetals, n.e.s.:			
Crude	16,959	--	
Slag, dross, similar waste, not metal bearing	857	480	Philippines 296; Malaysia 89; Bangladesh 73.
Oxides and hydroxides of magnesium, strontium, barium	9	11	All to Malaysia.
Bromine, iodine, fluorine value	$1,386	$1,589	Malaysia $1,408.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	577	1,635	Mainly to Malaysia.
Carbon, black	1,285	738	Malaysia 542.
Coal, all grades, including briquets	301	148	Bangladesh 51; Philippines 27; Thailand 21; India 18.
Coke	3,518	4,974	Malaysia 4,669.
Hydrogen, helium, rare gases value, thousands	$198	$164	Malaysia $37; Hong Kong $35; Thailand $26; India $24; Philippines $23.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	1,886	8	All to United States.
Refinery products:[4]			
Gasoline:			
Aviation do	670	529	Australia 197; New Zealand 96; New Guinea 71; Thailand 52.
Motor do	6,276	5,846	Australia 1,144; Hong Kong 805.
Kerosine and jet fuel do	14,343	14,001	United States 4,349; Hong Kong 3,719.
Distillate fuel oil do	20,151	19,184	Hong Kong 4,095; Malaysia 4,081; Australia 3,381; Thailand 3,260.
Residual fuel oil do	34,191	42,385	Hong Kong 14,655; Japan 14,389; Australia 6,698.
Lubricants do	2,181	2,587	Malaysia 772; Thailand 683.
Mineral jelly and wax do	280	246	Brazil 20; Malaysia 16; Philippines 15.
Other:			
Naphtha do	10,634	9,631	Malaysia 7,001; Philippines 1,260.
Nonlubricating oils, n.e.s. do	29	36	Malaysia 15; Saudi Arabia 7; United Arab Emirates 3.
Pitch and petroleum coke do	2	8	Mainly to Malaysia.
Bitumen and bituminous mixtures, n.e.s do	1,037	1,100	Australia 208; United Arab Emirates 200; Hong Kong 195; Malaysia 115.
Unspecified do	7,730	7,945	Japan 7,377.
Total do	97,524	103,498	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	759	710	Malaysia 501; Nigeria 170.

[r] Revised.
[1] Less than 1/2 unit.
[2] Listed under individual metals.
[3] Total excludes bricks of baked clay valued at $37,884 in 1975 and $34,274 in 1976.
[4] In addition to the products listed, liquefied petroleum gas valued at $17,733,428 in 1975 and $15,490,337 in 1976 was exported.

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Table 5.—Singapore: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS			
Aluminum:			
Bauxite and concentrate	12,612	5,397	Malaysia 5,196.
Oxide and hydroxide	2,255	4,138	Japan 1,731.
Metal including alloys:			
Scrap	352	377	Malaysia 349.
Unwrought and semimanufactures	8,935	14,846	Japan 4,487; Hong Kong 1,125.
Chromium oxide and hydroxide	81	104	West Germany 34; Hungary 18; Poland 10; U.S.S.R. 10.
Cobalt oxide and hydroxide	(1)	1	Mainly from France.
Columbium and tantalum metal kilograms	128	11	Austria 7; United States 3; West Germany 1.
Copper:			
Ore and concentrate value	r$3,462	$13	All from United States.
Metal including alloys:			
Scrap	1,497	1,368	Malaysia 1,245.
Unwrought and semimanufactures	11,162	15,648	Japan 9,127; United Kingdom 1,436; Australia 1,340.
Iron and steel:			
Ore and concentrate	23,712	77	United States 45; Malaysia 32.
Metal:			
Scrap	96,052	54,754	Australia 37,954; Malaysia 8,838; Hong Kong 6,918.
Pig iron including cast iron	71,901	21,800	India 12,000; Australia 3,195; Republic of Korea 3,020.
Sponge iron, powder, shot	887	608	Japan 316; United Kingdom 139.
Ferroalloys:			
Ferromanganese	1,562	705	Taiwan 342; Japan 320.
Other	1,444	4,082	Taiwan 1,920; Japan 842.
Steel, primary forms	101,279	136,728	Australia 85,328; Japan 33,210.
Semimanufactures:			
Bars, rods, angles, shapes, sections	355,042	297,345	Japan 256,901.
Universals, plates, sheets	435,857	422,883	Japan 382,062.
Hoop and strip	12,608	21,182	Japan 18,478.
Rails and accessories	10,899	11,192	Taiwan 7,851; United Kingdom 2,230.
Wire	13,381	13,626	Japan 4,674; Netherlands 1,574.
Tubes, pipes, fittings[2]	305,303	132,488	Japan 76,600.
Castings and forgings, rough	4,812	2,372	Japan 792; Malaysia 438; United States 405; India 248.
Total	1,137,902	901,088	
Lead:			
Ore and concentrate	10	--	
Oxides	548	747	Australia 646.
Metal including alloys:			
Scrap	191	255	United States 122; Malaysia 67; Brunei 24.
Unwrought	2,590	3,629	Australia 2,599; Thailand 375.
Semimanufactures	456	744	Australia 470; United Kingdom 79.
Magnesium metal: Unwrought and semimanufactures	13	12	Japan 9; Australia 1.
Manganese:			
Ore and concentrate	23,709	18,293	United States 6,385.
Oxides	538	676	Japan 353; United States 300.
Mercury 76-pound flasks	7	280	Spain 200.
Molybdenum metal including alloys, all forms	27	2	Mainly from United States.
Nickel metal including alloys:			
Scrap	9	2	Canada 1; Malaysia 1.
Unwrought and semimanufactures	141	273	Canada 102; United Kingdom 45; United States 40; Japan 33.
Platinum-group metal and silver:			
Platinum group troy ounces	2,025	6,398	Japan 3,119; United States 1,125; United Kingdom 1,029; Australia 1,029.
Silver do	223,897	429,437	Japan 214,188; Australia 88,832; United States 79,380.
Tin:			
Ore and concentrate	37	982	Thailand 541; Burma 432.
Oxides	2	1	Mainly from United States.
Metal including alloys:			
Scrap	205	38	All from Malaysia.
Unwrought and semimanufactures	1,249	978	Malaysia 549; Hong Kong 212.
Titanium:			
Ore and concentrate	196	25	Mainly from Australia.
Oxides	1,984	2,949	Japan 790; Australia 749; United Kingdom 539; Germany 464.

See footnotes at end of table.

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Table 5.—Singapore: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
METALS —Continued			
Tungsten:			
Ore and concentrate	10	153	All from Thailand.
Metal including alloys, all forms	52	44	Japan 40; United States 4.
Zinc:			
Ore and concentrate, value	$726	$2,979	All from United Kingdom.
Oxides and peroxides (except hydroxides)	336	418	Malaysia 91; France 76; United Kingdom 74; United States 49.
Metal including alloys:			
Scrap	108	396	Malaysia 376.
Blue powder	528	341	Australia 235; Japan 42; United States 38.
Unwrought and semimanufactures	9,739	12,093	Japan 3,961; Canada 2,789; Australia 1,787.
Zircon	31	35	Mainly from Australia.
Other:			
Ash and residue containing nonferrous metals	52,446	28,716	Australia 13,628; Japan 12,400.
Oxides, hydroxides and peroxides of metals, n.e.s	175	266	Germany 90; Japan 66; United Kingdom 61.
Metals including alloys, all forms:			
Scrap, nonferrous	(3)	(3)	
Metalloids	22	33	Japan 27.
Alkali, alkaline earth, rare-earth metals	7	10	United States 5; U.S.S.R. 3; West Germany 1; France 1.
Pyrophoric alloys	(1)	101	Austria 40.
Base metals including alloys	1,237	247	Thailand 59.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	270	203	India 55; United States 39; Greece 31; Italy 22.
Dust and powder of precious and semiprecious stones, value	$3,540	$2,093	Japan $1,214; Belgium-Luxembourg $477; United States $251.
Grinding and polishing wheels and stones	724	707	Japan 308; Taiwan 76.
Asbestos	10,341	3,322	Australia 2,130; Canada 1,133; West Germany 322.
Cement, thousand tons	1,309	1,600	Japan 1,141.
Clays and clay products (including all refractory brick):			
Crude:			
Kaolin	2,464	2,741	Malaysia 2,145; United Kingdom 354.
Other	24,894	23,208	United States 14,027; Malaysia 3,147; Austria 2,453.
Products:			
Refractory (including nonclay brick)	12,520	8,577	Japan 1,725; United Kingdom 1,474; Malaysia 1,174.
Nonrefractory[4]	83,867	52,101	Japan 12,492; Italy 11,802; Philippines 7,131.
Diamond:			
Gems, not set or strung, value, thousands	$15,798	$12,667	India $7,181; Belgium-Luxembourg $2,230; Israel $1,543.
Industrial, do	$11,744	$337	United Kingdom $322.
Diatomite and other infusorial earth	604	232	United States 178; Japan 36.
Feldspar and fluorspar	2,681	5,572	India 5,386.
Fertilizer materials:			
Crude:			
Nitrogenous	30	108	All from West Germany.
Phosphatic	24,611	27,199	Christmas Island 23,120; Israel 3,994.
Manufactured:			
Nitrogenous	37,323	40,461	Japan 17,385; Saudi Arabia 15,910; Germany 4,011.
Phosphatic	154,268	2,796	United States 2,102; Japan 400.
Potassic	194,850	186,924	Canada 75,346; Israel 50,466; West Germany 19,527.
Other, including mixed	67,900	23,571	West Germany 10,294; Belgium-Luxembourg 8,453.
Ammonia	294	398	Malaysia 167; Japan 132; United States 54.
Graphite, natural	198	215	United States 27; Republic of Korea 25; United Kingdom 22.

See footnotes at end of table.

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Table 5.—Singapore: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
NONMETALS —Continued			
Gypsum and plasters	46,120	69,988	Australia 35,630; Japan 30,600.
Lime	16,067	16,442	Malaysia 16,316.
Magnesite	43	59	Norway 31; Japan 10; Malaysia 5.
Mica, all forms	882	407	United States 347.
Pigments, mineral:			
Natural, crude	290	341	United Kingdom 6; Malaysia 5.
Iron oxides, processed	725	702	West Germany 368; Spain 55.
Precious and semiprecious stones, except diamond, worked and unworked:			
Natural value, thousands	$9,486	$5,928	Hong Kong $1,963; Kenya $1,689; Sri Lanka $828; New Zealand $662.
Manufactured do	$114	$222	Thailand $76; India $58; Japan $45; Hong Kong $25.
Salt and brine	39,941	46,898	Thailand 21,470; India 10,931; Australia 10,922.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	9,081	17,341	United States 7,105; Italy 3,360; Japan 1,632; Romania 1,149.
Caustic potash, and sodic and potassic peroxides	311	591	Belgium-Luxembourg 282; Hong Kong 164; Japan 86.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	31,272	67,388	Malaysia 63,095.
Worked	6,649	10,914	Italy 5,149.
Dolomite, chiefly refractory grade	485	1,848	Malaysia 1,256; Sweden 586.
Gravel and crushed rock	605,065	1,181,796	Malaysia 1,177,104.
Limestone (except dimension)	15,041	24,255	Malaysia 23,969.
Quartz and quartzite	179	355	Malaysia 274; Australia 76.
Sand, excluding metal bearing	43,208	217,599	Malaysia 212,524.
Sulfur:			
Elemental:			
Other than colloidal	2,627	267	United States 102; Thailand 50; Taiwan 30; France 26.
Colloidal	474	405	United States 300.
Sulfur dioxide	2	3	Mainly from United Kingdom.
Sulfuric acid	86	297	Malaysia 213; Thailand 37; United States 27.
Talc, steatite, soapstone, pyrophyllite	5,711	8,025	Republic of Korea 2,232; India 132.
Other nonmetals, n.e.s.:			
Crude	32,646	64,603	West Germany 56,404; Malaysia 7,196.
Slag, dross, similar waste, not metal bearing	5,971	2,759	Malaysia 1,651; Taiwan 450; Republic of Korea 200.
Oxides and hydroxides of magnesium, strontium, barium	37	101	Japan 40; West Germany 26; United States 19; Taiwan 10.
Bromine, iodine, fluorine value	$15,047	$49,169	France $34,675; Japan $7,431.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	5,338	3,178	Malaysia 2,756.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	667	1,101	Republic of Korea 850; United States 144.
Carbon black	2,766	4,012	Japan 2,424; Australia 910.
Coal, all grades, including briquets	1,589	499	United States 337; Japan 145; Malaysia 45.
Coke	5,000	9,881	Japan 5,400; Taiwan 2,440; West Germany 2,015.
Hydrogen, helium, rare gases value, thousands	$401	$275	Japan $103; Australia $73; United Kingdom $37; United States $34.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	133,248	[5]156,482	Saudi Arabia 102,123; Iran 19,328; Iraq 9,792.
Refinery products:			
Gasoline:			
Aviation do	688	519	All from Iran.
Motor do	1,314	713	Bahrain 387; Iran 297.
Jet fuel do	1,820	683	Republic of Korea 259; Iran 177; Saudi Arabia 141; Australia 72.
Kerosine do	1,659	971	Malaysia 809; Saudi Arabia 97.

See footnotes at end of table.

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Table 5.—Singapore: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum —Continued			
Refinery products —Continued			
Distillate fuel oil thousand 42-gallon barrels	4,579	4,310	Bahrain 2,009; Saudi Arabia 1,405.
Residual fuel oil do	22,371	35,144	Saudi Arabia 13,885; Iran 6,567; Bahrain 5,288.
Lubricants do	666	535	Philippines 144; Malaysia 141.
Mineral jelly and wax do	8	55	Burma 19.
Other:[6]			
Nonlubricating oils, n.e.s. do	20	32	Malaysia 9; United States 8.
Pitch and petroleum coke do	13	18	United States 12; Japan 2; United Kingdom 2.
Bitumen and bituminous mixtures, n.e.s do	26	15	Malaysia 7; United States 3; Netherlands 2.
Unspecified do	2,874	3,608	Malaysia 2,037; Iran 538; Saudi Arabia 423.
Total do	36,038	46,603	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	5,955	r3,990	United Kingdom 1,527; Australia 1,249; Japan 634.

rRevised.
[1]Less than 1/2 unit.
[2]Total excludes quantity valued at US$287,126 for 1975 and US$812,892 for 1976.
[3]Listed under individual metals.
[4]Total excludes brick of baked clay valued at US$757,268 in 1975 and US$1,073,845 in 1976.
[5]Total excludes quantity valued at US$38 in 1976.
[6]In addition to products listed, liquefied petroleum gas valued at US$235,957 in 1975 and US$19,567 in 1976 was imported.
[7]Total excludes quantity valued at US$4,106 in 1976.

COMMODITY REVIEW

Metals.—*Iron and Steel.*—Singapore's steel imports were about 1 million tons in 1977 and in 1976 and 1.4 million tons in 1974, with Japan by far the leading supplier. Steel imports in 1977 were worth about $200 million. About two-thirds of the steel imports from Japan consisted of shapes, plates, pipe, and tubing. The steel ingots locally produced, which amount to about 200,000 tons annually, are derived from scrap. The ingots along with imported materials are then made mainly into rolled semimanufactures.

Reportedly, there were 14 small iron and steel establishments in 1977, employing about 1,450 workers. Only two steel producers were of any consequence—National Iron and Steel Mills, Ltd. (NISM), and Malayan Iron and Steel Mills, Ltd. NISM's plant at Jurong has electric furnaces, merchant bar mills, and a wire rod mill which together turn out more than 200,000 tons of steel products annually. Malayan Mills' facilities are considerably smaller than those of NISM. NISM and Japan's Mitsui & Co., Ltd., have a joint venture called Eastern Wire Manufacturing Co.

Tin.—Although this 200-square-mile island nation has no tin production, it plays a key role as a leading clearinghouse for Southeast Asia's tin smuggling syndicates.[29] Singapore's imports of tin-in-concentrates rose from 37 tons in 1975 to 982 tons in 1976 to 2,290 tons in 1977. The country's largest tin buyer, Kin Hok, has begun to operate its own tin smelter, rated at 150 tons per month, to smelt part of the smuggled in concentrates. In 1976 when the smelter was not yet built, official imports of concentrates (about 72% grade) were 982 tons compared with exports of 5,498 tons; corresponding figures for the first 6 months of 1977 were 943 tons and 4,030 tons. Tin, of course, was worth over $10,000 per ton. Custom officials have been unable to stop the steady stream of concentrates brought in by small boats, trucks, and private cars from Malaysia, Indonesia, Thailand, and Burma. About 10 small firms handle the influx. Customs records show that exported concentrates go mainly to the smelters in Spain, the Soviet Union, Brazil, and secondarily to Mexico, Portugal, Republic of Korea, and Taiwan.

Nonmetals.—*Cement.*—Singapore had seven cement and cement additive establishments in 1977, employing about 570

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workers and realizing S$47 million (US$19.5 million) worth of value added from an output of S$169 million and an input of S$123 million. Virtually all are grinding operations, relying on imports of clinker. In 1976, Singapore's imports of such clinker were 1.58 million tons, 72% from Japan and 22% from the Republic of Korea and Taiwan combined. Output of finished cement corresponded closely to the amounts of clinker imported. Singapore's imports of finished cement have always been considerably less than 100,000 tons annually. Construction has averaged about S$500 million yearly during 1972-77, which represented about 6% of the GNP. One of the large construction jobs in recent years was the Changi airport.

Ssangyong Cement Industrial Co. Ltd. of the Republic of Korea purchased a $32 million, 600,000-ton-per-year clinker grinding system from the Fuller Co. for its joint venture plant in Singapore.[30] This pollution-free plant with a 4,000-horsepower finish grinding mill and in-plant dust collectors started operations and was fully operative by mid-1977. Ssangyong's partners included the Development Bank of Singapore and the Afro-Asian Shipping Co. Pte., Ltd., both headquartered in Singapore. Three older cement plants can be identified—Asia Cement (Singapore) Pte., Ltd.'s 420,000-ton-per-year plant at Jurong; Singapore Cement Manufacturing Co. (Pte.), Ltd.'s 320,000-ton-per-year plant; and Pan Malaysia Cement Works Ltd.'s 260,000-ton-per-year plant at Jurong.

Mineral Fuels.—*Petroleum.*—Only Rotterdam, Netherlands and Houston, Tex., have larger petroleum refining complexes than Singapore. Singapore expanded its oil refining capacity to about 1 million barrels per day around the beginning of 1977. Shell Eastern Petroleum, Ltd. (Shell), had expanded its refinery on Pulau Bukom Island to 550,000 barrels per day, making this operation the world's second largest single refinery after another of Shell's refineries at Rotterdam. Esso Singapore Pte. Ltd. (Esso) has a 230,000-barrel-per-day refinery at Pulau Ayer Chawan; Mobil Oil Singapore Pte., Ltd., a 180,000-barrel-per-day refinery at the Jurong Industrial Estate; and Singapore Petroleum Co. Pte. Ltd. and B. P. Refinery Singapore Pte., Ltd., smaller refineries. The sharp increase in oil prices and the subsequent worldwide recession had cut down severely on the demand for Singapore's fuel oil. In early 1977, Singapore's refineries started to redesign facilities in order to handle lighter crude oil and to produce more distillates like automotive diesel oil and kerosine. Also, Singapore refineries had been designed for the high-sulfur crudes of the Middle East and some redesigning was contemplated in this area too.

Singapore's refiners moved toward building more capacity to produce lighter petroleum products. The Singapore Petroleum Co. installed a 15,000-barrel-per-day hydrocracking unit. Mobil Oil, as part of a major effort to upgrade its oil refining capacity announced a reformer expansion project to convert a 10,000-barrel-per-day naphtha facility to making gasoline. Royal Dutch Shell indicated that it intended to build a $144 million hydrocracking unit at its big refinery. Another dimension to Singapore's upstream oil activities is the expected construction of a large petrochemical complex on Pulau Ayer Merbau by a joint venture headed by Sumitomo Chemical Corp. of Japan.

Many international oil companies working in Southeast Asia have established headquarters in this small country. In fact, Singapore has been an oil logistics center in the Pacific for some time, with various kinds of seafaring oil exploration and development barges and equipment being built, assembled, and serviced here. Thus, slackening of oil exploration in Indonesia during 1976-77 affected Singapore's economy adversely.

SRI LANKA[31]

After 2 years of serious drought, Sri Lanka saw a return to normal rainfall in the latter part of 1976 and throughout 1977. The economy was strongly agrarian and major crops responded to the favorable conditions with significantly increased yields. The combination of good rainfall, more acreage under cultivation, and increased use of fertilizers produced a record paddy harvest of 80.4 million bushels (about 1.15 million tons of milled rice) in 1977. This surpassed the one-time harvest peak of 77 million bushels in 1970. The favorable agricultural output led the economy to a 4.4% gain in GNP at constant 1959 prices. GNP at current prices was $3.18 billion in 1977.

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Estimated breakdown by sector was as follows: 52.8% services; 32.0% agriculture; 12.6% manufacturing; and 2.6% mining.

From a record high deficit of $202 million[32] in 1975, Sri Lanka's trade balance improved dramatically in the following years. A sharp rise in export earnings finally produced a trade surplus of $54 million in 1977, the first such surplus since 1956. Total exports increased about 30% over those of 1976 to $726 million, while imports increased by only about 5% to $672 million.[33] The increase in imports were due to a larger volume of food purchases. The plantation crops of tea, rubber, and coconuts accounted for about three-fourths of the value of Sri Lanka's exports and provided employment for over 1 million workers.

The social welfare programs of the last 7 years, have led to a higher literacy rate, better health conditions, and a better standard of living for the average citizen. However, private foreign investment money was scarce because of fear of nationalization. Strikes and other problems in the transportation network led to periodic shortages of food and other essential commodities. The result of these external and internal difficulties was that real economic growth was slow and unemployment grew to 20% of the labor force.

The United National Party (UNP) won the July 1977 general elections. The new UNP Government, headed by Junius R. Jayewardene, began a program to reform the economy and accelerate economic growth. How much the changes in economic policy will affect the mineral industry remains to be seen.

COMMODITY REVIEW

Sri Lanka has been famous for its precious and semiprecious gems since ancient times and is still one of the major world producers of sapphire, ruby, cat's eye, and alexandrite. Gem production accounted for over 80% of the value of mine output.[34] Gems have become the principal nonagricultural export for Sri Lanka as a result of various incentives offered by the Government in 1972. Exports of gems reached an alltime high in 1976 but declined by 12% to about $29 million in 1977. The decline was believed to be owing largely to the uncertainties of the new Government's economic policies and the termination in late 1977 of the convertible rupee account (CRA), which had permitted gem traders to convert 20% of export earnings into free foreign exchange for import purposes.[35] The CRA had been a very effective incentive, considering the otherwise extremely tight controls on the importation of most consumer or luxury items.

Despite the economic incentive to deal through legitimate channels, it was estimated that smuggling accounted for 30% of the gem trade and that this proportion would probably increase with the withdrawal of the incentives. In addition to direct exports, domestic sales of gems and jewelry to foreign tourists during 1977 was $8 million.

During the year, gems were exported to 25 countries. Among these, Japan accounted for roughly 40%, followed by Hong Kong with 28%, Switzerland with 8%, and the United States with 7%. Sapphire accounted for about 64% of the total value.[36]

The public sector State Gem Corporation (SGC), which was established in 1971, handled the purchase and export of gems and issued licenses for private miners and dealers. SGC also cuts, polishes, and sells gems and jewelry. It introduced new testing and electric cutting and polishing machines in its own plant, but most of the country's gems were cut and polished in the villages by hand-built and hand-operated machines.

About 80% of the gem fields were located in Sabaragamuwa Province in the southwest part of the island. Ratnapura district, where traditional pit and tunnel manual mining by family or small groups continued, was the richest area. About 7,000 pits were believed to be in operation. The only mechanization was the use of some pumps in the deeper pits to remove water. The deposits are alluvial in nature and efforts to categorize the reserves or locate the primary sources have been unsuccessful.

By far the second most valuable mineral-derived product was cement. Production was over 355,000 tons in 1977, valued at about one-half the gem output total. Total capacity of the Puttalam and Kankesanturai plants was listed as 710,000 tons per year, but they have not run at nearly their designed rate for several years. A small clinker grinding plant at Galle operated on material supplied by the other two plants.

There were plans to increase production capacity because of anticipated higher demand. One plan would add a 1,200-ton-per-day kiln at the Kankesanturai plant. The other would start from scratch with a new plant in the Mannar district. The supply of

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raw materials is close to the Mannar site, but power and water supplies are scarce in that area. In view of the present excess capacity, the expansion will probably not occur for several years.

Natural graphite production in Sri Lanka ranked sixth in the world in 1977 and was the country's second ranking mineral export in terms of value. Production from the two major active mines—Bogala and Kahatagaha-Kolongalla—totaled 8,875 tons in 1977, a 7% increase over 1976 production. Total exports were 8,769 tons valued at about $2.5 million. Japan was the major importer, followed by the United States and the United Kingdom.

Two new prospects were under development, one at Rangala (7°21' N, 80°47' E) and the other at Ragedara. Commercial production was scheduled to begin at Rangala during 1979. Several additional years will be needed to bring the Ragedara prospect into production. It was planned that the new operations would each produce 1,200 tons per year of graphite. In addition, detailed geological investigation was underway at Siyamballapitiya in the Kegalla district. Exploration was planned to begin in 1978 on a reported flake graphite deposit at Meegahatenne in the Kalutara district.

To further increase the recovery and export potential, the State Graphite Corporation (SGC) was seeking funds to expand the corporation's milling and flotation capacity from 300 to 1,000 tons per year. Foreign collaboration was being sought to set up an export-oriented graphite lubricant plant, and SGC was planning to add a heavy media flotation processing plant as well. The plant could use presently noncommercial low-grade ore and beneficiate it into the highest commercial grades.

Production of other minerals was mixed in 1977. Ball clay, kaolin, clay for brick, and feldspar all increased while salt, clay for cement, limestone, quartz, and titanium minerals all decreased. None of these minerals were of great significance outside the local economy. Their aggregate value was only about 8% of the total value of mineral output.

The output of ilmenite, rutile, and zircon dropped again in 1977 because of decreased demand by the Japanese, principal purchaser of Sri Lanka's ilmenite, and by the delay caused by reconstruction of the processing plant at the Pulmoddai mineral sands deposit. The entire rutile/zircon plant was moved from near Trincomalee to the site of the Pulmoddai deposit. The facilities were not only integrated with the magnetic ilmenite concentration plant but expanded and modernized as well at a cost of about $12 million. The complex now has an annual capacity of 86,000-96,000 tons of ilmenite, 12,000-14,000 tons of rutile and 6,000-8,000 tons of zircon from the processing of 130,000 tons of raw sand plus reclaimed tailings. The nonmagnetic tailings from the ilmenite plant are combined with reclaimed tailings from past operations and fed to the rutile/zircon plant for concentration. Some 300 tons per year of 70% monazite concentrate are also recovered and stockpiled.

An expansion of the ilmenite plant was scheduled for 1986 when the supply of accumulated tailings will be exhausted. Present sands being mined are running 70%-80% heavy minerals and are considered one of the richest in the world. Exports of ilmenite and rutile in 1977 were 41,000 tons and 200 tons, respectively.

It was reported that the iron/copper ore deposit at Seruvilia near Trincomalee was found to be good enough to warrant exploitation. The Government was seeking funding and foreign expertise on the development of the deposit. Plans were to try to utilize both the iron and the copper values in the ore. The Ceylon Steel Corp. would use part of the iron output in place of the presently imported iron billets.

Geological exploration proved 25 million tons of phosphate rock grading 33% P_2O_5 in the Eppawela area south of Anaradhapura. The Government was still planning for the large-scale exploitation of the deposits, and in 1978 will probably invite proposals for a two-stage development program. The first stage would be a mining, crushing, and grinding facility, and the second stage would be a super phosphate or magnesium calcium phosphate plant. A small crushing plant currently supplies about 20 tons per day for direct application on suitable perennial crops.

Construction continued on the ammonia/urea fertilizer complex at Sapugaskanda. The plant, designed mainly by Kellogg Overseas Corp., will be rated at 147,000 tons per year nitrogen content of ammonia and will use naphtha from the nearby petroleum refinery. Total cost of the plant, being financed by the Asian Development Bank, Kuwait, the Federal Republic of Germany, and India, will be approximately $150 million.

Sri Lanka produced no oil or gas during

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1977 and was entirely dependent on petroleum imports for its requirements. Crude oil imports rose slightly to an estimated 1.53 million tons valued at $149 million. The cost of the imports, however, increased 15% over that of 1976 because of world price increases. Saudi Arabia supplied about 60% of the crude and Iran the remainder. Exports of surplus naphtha, bunker oil, diesel, and jet fuel brought a return of $65 million.[37]

Sri Lanka's only petroleum refinery, at Sapugaskanda, was being expanded during the year. The new construction will increase production of the light distillates.

Table 6.—Sri Lanka: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum metal including alloys, all forms	1,652	2,415
Arsenic trioxide, pentoxide, acid value	$4,847	$11
Copper metal including alloys, all forms	1,257	1,190
Iron and steel, metal:		
Scrap	--	--
Pig iron, ferroalloys, similar materials	156	437
Steel, primary forms	20,772	15,242
Semimanufactures	22,059	21,746
Lead metal including alloys, all forms	439	532
Manganese oxides	31	66
Mercury 76-pound flasks	4	31
Nickel metal including alloys, all forms	6	501
Silver metal including alloys troy ounces	8,502	4,019
Tin metal including alloys, all forms	167	51,665
Titanium oxides	77	103
Tungsten metal including alloys, all forms	(1)	(1)
Zinc:		
Oxide	452	424
Metal including alloys, all forms	236	571
Other:		
Ore and concentrate	1,010	788
Oxides, hydroxides, peroxides of metals, n.e.s	11	62
Metal:		
Alkali, alkaline earth, rare-earth metals value	$11,041	$5,387
Pyrophoric alloys do	$13	$10
Base metals including alloys, all forms, n.e.s	21	10
NONMETALS		
Abrasives, natural	96	98
Asbestos	789	2,908
Barite and witherite	--	4
Boron materials, oxide and acid	22	59
Cement	914	408
Chalk	20	(1)
Clays and clay products (including all refractory brick):		
Crude	708	1,848
Products:		
Refractory	10,097	2,052
Nonrefractory	1,327	50
Diamond, gem carats	--	10
Diatomite and other infusorial earths	15	8
Feldspar and fluorspar	15	10
Fertilizer materials:		
Manufactured:		
Nitrogenous	72,272	59,995
Phosphatic	56,072	17,920
Potassic	27,084	10,001
Mixed	9,136	22
Ammonia	188	2,406
Gypsum and plasters	24,720	821
Lime	89	--
Magnesite	41	42
Mica, all grades	15	1
Pigments, mineral, including processed iron oxides	8	45
Precious and semiprecious stone, excluding diamond carats	2,117	5,951
Salt	2	17
Sodium and potassium compounds:		
Caustic soda	2,300	2,406
Caustic potash	23	1,007
Stone: Dimension stone, worked	(1)	34
Sulfur:		
Elemental:		
Other than colloidal	575	66,395
Colloidal	142	42
Sulfuric acid	1,253	214
Talc, steatite, soapstone, pyrophyllite	431	552
Other nonmetals, n.e.s.:		
Crude	1,393	5,005
Oxides and hydroxides of magnesium, strontium, barium	27	2

See footnotes at end of table.

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Table 6.—Sri Lanka: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	--	37
Carbon black	1,967	614
Coal, all types, including briquets	133	200
Coke	1,899	808
Hydrogen, helium, rare gases	54	4
Petroleum and petroleum refinery products:		
Crude and partly refined --- thousand 42-gallon barrels	8,997	10,640
Refinery products:		
Gasoline ---do---	5	9
Kerosine and jet fuel ---do---	56	--
Distillate fuel oil ---do---	(1)	--
Lubricants ---do---	9	24
Other:		
Liquefied petroleum gas ---do---	(1)	--
Unspecified ---do---	9	181
Total ---do---	79	214
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	942	1,804

[1]Less than 1/2 unit.

VIETNAM[38]

During the first full year of unification, rebuilding of the Socialist Republic of Vietnam's war-damaged industrial and agricultural base was essentially completed and efforts were turned to expanding the economy. The GNP in 1977 was estimated to be $7.3 billion at market prices. This was an average increase of nearly 30% over the $4.6 billion estimated for 1975. The U.S.S.R. and East European countries were the main external contributors to Vietnam's rebuilding program.

Government authorities were encountering difficulties in rehabilitating a war-damaged society and implementing new social programs. Unemployment persisted in the south, particularly in the densely populated Ho Chi Minh City area (formerly Saigon). A program of moving people from urban areas into newly opened rural land was proceeding as fast as practical. The Government's plan was to relocate 10 million people from high-density areas in the next 10-15 years. It was reported that about 500,000 to 700,000 persons had already left Ho Chi Minh City. A shortage of funds to develop virgin land, a serious increase in malaria, and a reluctance on the part of the people to move was hindering the implementation of the Government reforms. Despite the problems, however, almost 450,000 hectares of land left fallow during the war and 300,000 hectares of virgin land was put under cultivation during 1977. The crowded urban conditions were exacerbated by the reported 3% annual population growth rate. The official plan was to reduce this rate to 2.4% by 1980 and to 1.5% by 1990.

In June, the senior official in Ho Chi Minh City announced that all business and agriculture in what was once South Vietnam was to be fully collectivized by 1979. The state was to buy business facilities and inventories. Persons having technical and professional skills were to be employed in state-run trades.

The long-term objective of the Government was to establish heavy industry as the base for the economy. The immediate emphasis, however, was to alleviate acute food shortages and to greatly increase agricultural output. Of the total $7.5 billion outlay envisioned for the second 5-year plan (covering 1976-1980), $2.3 billion were earmarked directly for agricultural expansion, and a large proportion of the 35% allocated for industry was to go for the manufacture of products, equipment, or systems that would support or benefit the agricultural sector. Despite the plans and preparations, severe weather conditions, including a combination of abnormally cold temperatures in the north, drought in the Hanoi area and in the Mekong Delta, and local flooding from typhoon rains, seriously damaged the crops in 1977.

Vietnam was looking to increase trade with its Asian neighbors. During the year,

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more than 60% of its trade was with centrally planned economy countries. In order to encourage trade development and economic growth, the Government drafted foreign investment rules that would allow up to 49% foreign participation in a wide range of industrial activity on a profit-sharing basis. Exports in 1977 showed a substantial increase over those in 1976. According to foreign trade minister, Dang Viet Chau, exports from the north and south of Vietnam in 1976 totaled about $240 million.[39] Additionally, overall exports in 1977 had increased 37% to $328 million. Both the total 1976 level of exports and the rate of growth given by the foreign trade ministry were slightly higher than had been estimated by most foreign observers. Export increases were predicted to grow at a 40% annual rate until 1980. Although high-grade coal was Vietnam's largest export item, agricultural, fishing, and forestry products were also to be important trade items in the current development plan.

The value of Vietnam's imports from market economy countries was reportedly about $427 million in 1977.[40] Moreover, the volume of trade with the U.S.S.R. and other planned economy countries normally account for a considerable amount. The overall trade deficit was estimated between $600 million and $700 million. Most of Vietnam's imports were raw materials and fuel, machinery and equipment, and foodstuffs and products. In view of the growing needs for industry and infrastructure, the country's trade deficit was expected to rise to about $1 billion by 1980.

Rapid expansion of the electric power network continued during the year, with priority given to projects that supply power to the agricultural sector. The mining sector would also benefit indirectly from expanding the powerline network; small or marginal deposits, which would normally not warrant extension of a powerline, would have access to electricity from new lines that supply outlying pumping stations. Most of the electricity generated in the north was produced in plants fueled by domestic coal supplies, while the southern area is more dependent on hydroelectric as well as hydrocarbon fueled plants. The total capacity of irrigation pumping stations powered by electricity reportedly increased from 219 megawatts in 1976 to 237 megawatts in 1977. Total output of electric power was given as 3.36 billion kilowatt-hours during 1977, a 16% increase over that of 1976. The Government's target for electric power in 1978 was 3.9 billion kilowatt-hours. Total generating capacity of the country was reported as 1,300 megawatts.

The third generator of the Da Nhim hydroelectric plant in the south was repaired, bringing the plant capacity to 160 megawatts. Government experts were studying plans to expand the capacity to 300 megawatts. Two new 70-megawatt generators in a pumped storage configuration would provide the increase.

Construction was nearly finished on the 110-kilovolt powerline, 52 kilometers long from An Lac to Thai Binh. When completed, the line will connect the Ninh Binh thermal powerplant to the Haiphong municipal grid.

Preparatory work on the giant Da River hydroelectric project was reported in full swing during the year. Road construction to the site was underway; machine shops and workers' housing were under construction. The 1,664-megawatt powerplant and dam is sited just upstream of Hoa Binh, about 60 kilometers west-southwest of Hanoi. The Soviet Union was providing technical and economic aid for the construction.

Vietnam is not a major producer of any minerals by world standards. Production of coal, phosphate, chromite, tin, antimony, iron ore, brick, cement, and zinc, however, is sufficient to furnish the country's needs at this time. Modest amounts of coal, tin, and phosphates are exported. Data on production are seldom specific. The available figures are frequently stated in terms of percent increase over an unstated or unknown base period.

Cognizant of the value of mineral resources, the Government actively encouraged prospecting and evaluation of various mineral deposits throughout the country. The Government planned to develop local minerals, especially those that were needed to meet the immediate needs for fuels and raw materials required by industry, agriculture, and infrastructure. The Fourth Party Congress indicated that the mining sector must "both build large, modern enterprises and extensively develop medium- and small-scale enterprises in the localities."[41]

Some of the minerals mentioned in the press in 1977 as being slated for more detailed investigation, development, or exploitation included: Bauxite, copper, graphite, lead, manganese, silver, and titanium. Even if rich and sizable mineral deposits were to be found and exploited, a great deal of financial and technical resources would

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be required to bring them into commercial production. Most of the minerals are located in remote and rugged areas. The problem of transport alone could delay development of even some quite promising deposits.

Most promising in the long run may be the oil discovered offshore southern Vietnam by western companies in 1974. Undoubtedly, development of the fields would be most beneficial to the country's economy. No oil or natural gas was produced in the country during 1977. Again, a great deal of capital investment and sophisticated technology would be needed to bring the deposits into production and would necessitate external assistance.

COMMODITY REVIEW

Metals.—Antimony was known to be mined in the country and refined in the north at a small plant completed in 1976. Chromite is mined at one known location, Co Dinh in Thanh Hoa Province. Production reportedly exceeded the planned quota for 1977 and also probably exceeded the 9,000 tons of ore mined in 1976. The 1978 production target was to be a 25% increase over that in 1977. Some of the ore is probably made into refractory brick for furnace linings and the remainder exported to socialist countries as bulk ore. There is no ferrochromium plant in Vietnam.

In late 1977, a French steel engineering company signed a provisional contract to expand and modernize the facilities at the Thai Nguyen iron and steel complex. Some Japanese firms were also negotiating a contract for work at the same plant. Modifications to be included were a small blast furnace (250,000 to 500,000 tons per year) and two 30-ton converters to be purchased from the Japanese. The French would furnish engineering expertise, a continuous steel casting mill, and a bar and angle rolling mill. Vietnam was to provide all necessary improvements to infrastructure before start of construction. Thai Nguyen was reportedly producing pig iron at a rate of 450 tons per day in late 1977. The Nui Coc dam, under construction throughout 1976, was completed in 1977. The reservoir will store 175 million cubic meters of water to supply the cooling needs of the Thai Nguyen complex and for nearby irrigation projects.

Iron ore for Thai Nguyen was supplied mainly from the nearby Trai Cau mine. Large iron ore reserves have been reported in the highlands about 100 kilometers south of Da Nang. Vietnam is not self-sufficient in steel production and imported at least 130,000 tons of steel products from Japan in 1977. The U.S.S.R. and Eastern European countries may also have supplied additional amounts.

Tin was mined mainly in Cao Bang and also near Vinh and Viet Tri. Concentrates were refined at the Tinh Tuc refining plant in Cao Lang Province, northeast of Hanoi. Production of tin-in-concentrate was estimated between 200 and 250 tons in 1977. The 1978 production plan called for a 17% increase in tin metal. Some tin was exported to the U.S.S.R.

Zinc ore deposits are found at Trang Da and Cho Dien, and a small zinc smelter is located at Quang Yen. There was no mention in the press during the year of zinc output or projected increases in the 5-year development plan. Production was probably quite low.

Nonmetals.—Because a shortage of building materials continued to plague construction in 1977, the Government sought to increase the level of brick and construction tile production in every way possible. Local districts, especially those in the southern provinces, were urged to open clay pits and to develop small- and medium-scale brick kilns of 1 to 7 million pieces per year capacity. This could be accomplished quickly with modest investment and using locally made equipment and local labor. Mechanization and expansion would come later as equipment and funding became available. Construction also continued on large plants. The large (20-50 million brick) Gieng Day factory was completed during 1977. Location of this facility was not disclosed. Brick plants with capacities of between 7 and 20 million brick were completed during the year at Trung Gia, Chien Thang, Te Tieu, and Krong Pach. At least four others were under construction.[42]

The planned brick production in 1978 was to be 3.5 billion units, a 14% increase over output in 1977, indicating a small shortfall of 0.13 billion brick from the 1977 target of 3.2 billion. In 1976, production was 2.4 billion brick and 0.5 billion tile. Tile production was believed to have dropped a small amount in 1977. The brick and tile production represents a dry weight of clay of over 9 million tons for the year, the largest mineral output by weight in Vietnam.

Vietnam produced about 700,000 tons of cement in 1977, about 18% of which was from various small local kilns. There were

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only two rotary kiln plants operating in 1977, one in Haiphong in the north, the other in Hà Tiên in the south. Authorities were striving to increase output with a large expansion program, both in building more small local kilns and in using foreign aid in the construction of large modern rotary kiln plants. The state plan called for completion in 1978 of 26 local plants, each with a capacity of 5,000 to 10,000 tons per year. Planned output for 1978 was 986,000 tons.

The second 5-year plan envisioned increasing cement output to 2 million tons by 1980. In late stages of planning or under construction were rotary kiln plants at Binh Son (Soviet assistance for a 1.2-million-ton-per-year plant); Hoang Thach (Japanese and Danish assistance for a 1.0-million-ton-per-year plant); and Ha Tien (French assistance for a 1.0-million-ton-per-year expansion of the old plant). Also planned were large plants at Phu Ly and Thanh Hoa.

Lime production was also important to the Vietnamese economy. Installed capacity yearend was reported at 2 million tons, and production was probably near that level. The current development plan called for an output of 3 million tons by 1980. About 80% of production goes to the agricultural sector.

In order to support the drive for higher crop yields, the Government placed a high priority on developing the fertilizer industry. Over 20 new fertilizer plants were under construction or put into operation during 1977. These were mostly apatite grinding plants of various capacities. A few had capacities of 20,000 tons per year and others, 100,000 tons per year, but most were apparently standardized plants rated at 40,000-60,000 tons per year. Some of the plants had roasting facilities to improve the solubility of the apatite before grinding.

Most of the apatite production was from the large Lao Cai (Laokay) mine near the Chinese border in the northwest. Total production was certainly well over 1 million tons in 1977. Efforts were being made to increase the mine output, from 1.5 to 3.0 million tons by 1980.

Vietnam's total exports of phosphate were substantial but probably did not reach 1 million tons. Phosphate fertilizer production was reported at from 416,000 tons to 497,000 tons in 1977 (not designated as to P_2O_5 content or gross weight). The 1978 output of all types of phosphate fertilizer was planned at 740,000 tons, a nearly 50% increase. In addition, production of pulverized apatite ore for direct crop application will be doubled to 393,000 tons in 1978.

The only modern nitrogenous fertilizer factory was the Ha Bac plant in Bac Giang City. The plant was originally built in 1965 with Chinese aid then subsequently damaged. Reconstruction began in 1973 and work was reportedly completed in late 1976. Trial operations began soon afterward and an official inauguration was held in October 1977. The plant was believed to have a capacity of 54,000 tons per year nitrogen content of ammonia plus a downstream urea capability. About 20,000 tons of urea fertilizer (nitrogen content) were produced by the end of the year. Vietnam lacks self-sufficiency in nitrogen fertilizers, and imports of significant quantities will continue, even with the reopening of the Ha Bac plant.

The Haiphong glassworks reopened in October 1977. The plant was rebuilt and modernized with assistance from the German Democratic Republic. The plant will produce 20,000 tons per year of glass from domestic sands and other locally produced raw materials.

Mineral Fuels.—Presently coal is by far Vietnam's most important mineral commodity. Reserves of high-grade coal, mostly anthracite, total several billion tons. Production has been climbing steadily since 1973, and in 1977 the washed coal output was reported at just over 6 million tons. Government plans called for a target of 7 million tons in 1978 and 10 million tons in 1980. New mines were being built; old ones, modernized; and transportation, storage, and loading facilities were being improved. In 1978, capital investment in coal mine development was to increase 50%, raising the total labor force in the industry to 30,000 persons. In order to attain the 1978 goal, overburden removal at the open pit operations increased 42% and totaled over 22 million cubic meters in 1977.

Coal was Hanoi's best foreign exchange earner in the mineral sector. Most of the exports went to Japan, with smaller amounts shipped to a few nearby countries. Exports to Japan were revised to 503,000 tons in 1975.

At the beginning of 1977, nine foreign oil companies were negotiating with Petrovietnam (the state-owned Vietnam oil and gas company) for drilling rights off the Mekong Delta, south and east of Ho Chi Minh City. Norway had already signed the

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first agreement in late 1976. By late summer of 1977, Petrovietnam had signed agreements with three European consortia: Agip (ENI) of Italy, Elf Acquitaine of France, and Deminex Deutsche Erdol Versergungs-gesellschaft MBH of the Federal Republic of Germany.[43] Late in the year, a group of Canadian companies headed by Bow Valley Industries Ltd. signed a contract for rights in blocks 01 and 02. Although late to sign, Bow Valley had an advantage on the other firms because it had done extensive geophysical surveying work on these tracts in 1973. All agreements were preliminary in nature and binding contracts defining specific terms and payment conditions were still to be worked out at yearend.

A petroleum discovery by Vietnamese oil workers, aided by Soviet technicians, was reported by the press in April. The strike was in Thai Binh Province in the Red River Delta. Vietnamese officials said the find has the potential for commercial production. Unusually high down-hole temperatures complicate drilling efforts in the Delta.

There was no oil or natural gas produced in Vietnam in 1977. Combined north-south consumption of imported petroleum products was from 2- to 2.5 million tons in previous years. The 1976 plan called for stringent conservation measures and a total of only 1.6 million tons of imports. It was not known if this goal was met. Because of increased needs in the transportation, agriculture, and military sectors, the consumption figure for 1977 was probably around 2 million tons.

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[1]Prepared by Gordon L. Kinney, physical scientist.
[2]The Bangladesh fiscal year runs from July 1 through June 30.
[3]Where necessary, an exchange rate of US$1.00=Taka15.0 was used.
[4]U.S. Embassy, Dacca, Bangladesh. State Department Airgram A-058, July 4, 1978, pp. 1-2.
[5]Page 3 of work cited in footnote 4.
[6]United Nations. Small Industry Bulletin for Asia and the Pacific. No. 15, 1978, pp. 49-57.
[7]Prepared by Gordon L. Kinney.
[8]Far Eastern Economic Review. Asia 1979 Yearbook. Hong Kong, pp. 150-153.
[9]Where necessary, values have been converted from Brunei dollars (B$) to U.S. dollars at the rate of B$2.48=US$1.00 in 1975; B$2.39=US$1.00 in 1976; and B$2.3354=US$1.00 in 1977.
[10]Standard Chartered Review, March 1978, p. 25.
[11]One cubic meter of LNG equals about 22,000 cubic feet of natural gas. The 5 million tons of liquid equates to about 725 million cubic feet per day of natural gas.
[12]Prepared by E. Chin, physical scientist.
[13]Where necessary, values have been converted from Hong Kong dollars (HK$) to U.S. dollars at the rate of HK$4.62=US$1.00.
[14]Prepared by Gordon L. Kinney.
[15]Formerly referred to as Khmer Republic of Cambodia.
[16]Fertilizer International. No. 100, October 1977, p. 4.
[17]Prepared by Gordon L. Kinney.
[18]Far Eastern Economic Review. Asia 1978 Yearbook. Hong Kong, p. 234.
[19]FBIS-APA-78-53, Mar. 17, 1978, v. IV, No. 53, Supplement 2, p. 34.
[20]Prepared by E. Chin.
[21]Asia 1978 Yearbook. Far Eastern Economic Review Limited, Hong, Kong, 1978, pp. 259-262.
[22]Prepared by Gordon L. Kinney.
[23]The Nepal fiscal year runs from July 17 to July 16.
[24]Dollar figures have been converted from Nepal Rupees (NR) to U.S. dollars at the rate of US$1.00=12NR.
[25]Nepal Press Digest. V. 22, No. 23, June 5, 1978, p. 250.
[26]Prepared by K. P. Wang, supervisory physical scientist.
[27]Where necessary, 1977 values have been converted from Singapore dollars (S$) to U.S. dollars at the rate of S$2.42=US$1.00. In 1976, the average exchange rate was about S$2.45=US$1.00.
[28]Monthly Digest of Statistics (Singapore). V. 18, No. 4, April 1979, p. 17.
[29]Metals Week (New York). Nov. 14, 1977, p. 10.
[30]Rock Products (Chicago). April 1977, p. 94.
[31]Prepared by Gordon L. Kinney.
[32]Where necessary, values have been converted from Sri Lankan rupees (Rp) to U.S. dollars at the average rate of US$1.00=Rp7.05 for 1975, Rp8.46 for 1976, Rp9.15 for 1977, and Rp15.58 beginning Jan. 1, 1978.
[33]U.S. Embassy, Colombo, Sri Lanka. State Department Airgram A-65, June 30, 1978, pp. 1-10.
[34]Does not include cement.
[35]U.S. Embassy, New Delhi, India. Department of State Airgram A-49, Sri Lanka's Gem Industry, Mar. 9, 1978, pp. 1-3.
[36]Work cited in footnote 5.
[37]U.S. Embassy, New Delhi, India. Department of State Telegram 04016. May 1978. p. 1.
[38]Prepared by Gordon L. Kinney.
[39]Chanda, Nayan. V. N. Looks to Trade Prospects. Far Eastern Economic Rev. V. 99, No. 1, Jan. 6, 1978, pp. 67 and 68.
[40]China Trade Report. V. XVI, May 1978, p. 14.
[41]Hanoi Nhan Dan in Vietnamese. Jan. 26, 1976, p. 3.
[42]Hanoi Quan Doi Dhan Dan in Vietnamese. Mar. 10, 1978, pp. 1-4.
[43]Petroleum News. V. 8, No. 10, January 1978, p. 45.

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The Mineral Industry of Other Countries of the Near East

By Staff, Bureau of Mines

CONTENTS

	Page		Page
Bahrain	1207	Syria	1220
Jordan	1211	Yemen, People's Democratic Republic of	1222
Lebanon	1215	Yemen Arab Republic	1223
Oman	1215		
Qatar	1218		

BAHRAIN[1]

Bahrain's oil revenue increased from $337 million[2] in 1976 to $378 million in 1977. Despite the increase in value, petroleum receipts made up only 59% of all Government income in 1977, compared with 74% in 1976 and 83% in 1975. Bahrain became an oil producer in 1932 with the discovery of the Awali oilfield, and since that time, the Awali oilfield has produced over 600 million barrels of crude oil. Awali production in 1977 was 21.2 million barrels. Bahrain shares the revenue from the Abu Safah oilfield, located in the Persian Gulf north of Bahrain, equally with Saudi Arabia. Revenue from the Abu Safah oilfield was approximately $179 million or 47% of oil revenues in 1977. Output from the Abu Safah oilfield was 48 million barrels, an increase of nearly 30% over 1976 output.

The Bahrain Petroleum Company (BAPCO), the nation's only oil-producing company, was owned 40% by California Texas Oil Corp. (CALTEX) and 60% by the Government. The Government established Bahrain National Oil Co. (BANOCO) in 1976 to administer the Government's share of BAPCO, oversee exploration concessions, and manage domestic marketing of petroleum products. The Government announced its intention to acquire 100% control of crude oil and natural gas production. CALTEX was to retain complete control of the 250,000-barrel-per-day oil refinery near Sitrah.

During 1977, the BAPCO oil refinery processed 95.2 million barrels of crude oil and blended stocks, averaging 260,800 barrels per day for a record-setting year. The refinery processed all of Bahrain's crude oil output and an additional 73.2 million barrels of crude oil that was supplied from Saudi Arabia by pipeline. The BAPCO refinery is an export-oriented enterprise and feeds a tank farm on Sitra Island. Petroleum products from the tank farm were pumped 3.5 miles to a six-berth, deepwater marine terminal. The terminal can accomodate vessels up to 110,000 deadweight tons. Refinery storage capacity was 7 million barrels for petroleum products and 6 million barrels for crude oil.

During 1977, natural gas production in-

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creased 12.7% from 8.34 million cubic meters per day to 9.4 million cubic meters per day. Production came from the Permian Khuff formation, which occurs between 8,500 feet and 10,500 feet and is below the Bahrain formation (1,800 to 2,300 feet). Khuff gas was used to feed the 300-megawatt powerplant of Aluminum Bahrain Ltd. (ALBA), maintain pressure in the Awali oilfield, fuel the petroleum refinery's low-sulfur fuel oil complex and power station, operate the Government's powerplant at Jufair, and provide an energy source for desalination of seawater. Natural gas produced in association with crude oil, about 3 million cubic meters per day, was flared in 1977.

ALBA's 120,000-ton-per-year aluminum smelter, owned 77.9% by the Bahraini Government, 17% by Kaiser Aluminum Bahrain, and 5.1% by Breton Investment, produced 121,356 tons in 1977. The main products were standard, 22.5-kilogram ingot (95,100 tons), "T" ingot (10,100 tons), and extrusion billets (6,800 tons). Other products included liquid metal for local downstream industries and small amounts of conductor bars and anode rod for in-house use. Raw materials for aluminum production were imported from Australia (alumina and pitch), the United States (petroleum coke), and Italy and Japan (cryolite and aluminum fluoride). Most of the materials used by ALBA were received at the company's own bulk materials handling terminal that was on an artificially created 3-acre island, approximately 5 kilometers offshore on the edge of the eastern reef. A 170-meter-long quay with its unloading cranes was able to berth one 35,000-ton bulk carrier at its seaward berth and a 12,000-ton vessel at its landward berth. The island was connected to the smelter by a 10-kilometer aerial ropeway that had 156 buckets, each of 1-ton capacity. A causeway connected the island to the Sitra-BAPCO causeway, providing a road connection to the main Bahrain island.

ALBA has not expanded into semimanufacturing operations, but several small companies convert part of the smelter's output into other products. Bahrain Aluminum Extrusion Co., a Government-owned enterprise, began production in March 1977. The company produced mainly architectural sections and had a rated capacity of 4,000 to 5,000 tons per year of anodized extrusions. Output in late 1977 averaged approximately 250 tons per month. Bahrain Atomisers International was located close to the ALBA smelter and used liquid aluminum for the production of aluminum powder. During 1977, Midal Cables Ltd. was formed as a joint venture between Intersteel of Bahrain (51%) and Olex Cables of Australia (49%). The company began construction of a facility adjacent to the ALBA smelter in 1977 and was to be in full production by mid-1978. A holding furnace was to accept liquid aluminum from ALBA and feed a continuous-casting and rolling section for the production of 3/4-inch-diameter rod, that would be drawn into aluminum cable. Planned capacity was 15,000 tons per year of aluminum cable to be marketed in the Persian Gulf area.

Bahrain continued to import large quantities of cement during 1977. In November, the Government of Bahrain and Saudi Cement Co. signed an agreement with Ishikawajima Harima Heavy Industries Co., Ltd. of Japan to build a four-kiln, 6,000-ton-per-day cement plant. The cement plant was to be erected near Ain Dar in Saudi Arabia's Eastern Province and was to be in full operation in 1982.

The construction phase of a major shipyard facility was concluded in December with the inauguration of the drydock at the Arab Shipbuilding and Repair Yard Co. The shipyard was built on a 124-acre site reclaimed from the sea off the southeastern end of Muharraq Island. The major feature of the facility was a 375-meter-long by 75-meter-wide drydock that could accommodate vessels of up to 500,000 deadweight tons. Sill depth at the dock's gate was 9 meters. The shipyard was sponsored by the Organization of Arab Petroleum Exporting Countries (OAPEC) and was the largest facility of its kind between the Suez Canal and Singapore.

Expansion of Bahrain's major port, Mina Sulman, was underway in 1977 to increase the number of berths from 8 to 13 and to enlarge open storage areas. Improved handling procedures and the hiring of contract dock workers essentially eliminated the ship waiting time, which had been as high as 70 days. The port handled 1.52 million tons of cargo in 1977 and docked 781 vessels. A large volume of Bahrain's imports was reexported to Saudi Arabia, Qatar, and the United Arab Emirates during 1977.

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Table 1.—Other Countries of the Near East: Production of mineral commodities

Area, commodity, and unit of measure	1975[r]	1976	1977[p]
BAHRAIN[1]			
Aluminum, primary smelter—metric tons	116,300	122,058	121,356
Gas, natural:			
Gross production—million cubic feet	101,546	107,464	121,228
Marketed production—do	[r]72,804	76,931	83,392
Petroleum:			
Crude—thousand 42-gallon barrels	[r]22,309	21,287	21,236
Refinery products:			
Gasoline—do	9,667	9,520	9,829
Jet fuel—do	8,842	8,833	11,743
Kerosine—do	2,939	5,361	3,265
Distillate fuel oil—do	20,733	19,475	23,571
Residual fuel oil—do	28,052	26,476	33,687
Lubricants—do	---	---	344
Other—do	6,186	9,084	10,523
Refinery fuel and losses—do	2,256	1,257	2,271
Total—do	78,675	80,006	95,233
Sulfur, byproduct from petroleum—metric tons	24,800	10,000	7,000
JORDAN			
Cement, hydraulic—thousand metric tons	572	533	566
Clays—do	10	12	6
Fertilizer materials: Crude phosphate rock—do	1,353	1,717	1,782
Gypsum—do	30	21	22
Iron and steel semimanufactures—do	31	42	[e]42
Lime—do	3	3	3
Petroleum refinery products:			
Gasoline—thousand 42-gallon barrels	1,684	1,729	1,954
Jet fuel—do	584	834	872
Kerosine—do	899	1,241	829
Distillate fuel oil—do	1,673	2,505	2,604
Residual fuel oil—do	969	1,601	1,558
Other:			
Liquefied petroleum gas—do	296	428	394
Asphalt—do	222	385	497
Unspecified—do	---	4	---
Refinery fuel and losses—do	332	516	559
Total—do	6,659	9,243	9,267
Salt—thousand metric tons	16	20	30
Stone:			
Limestone—do	3,500	5,000	5,000
Marble—thousand square meters	1,150	150	(2)
LEBANON[1]			
Cement, hydraulic—thousand metric tons	[r]1,656	[e]1,704	1,360
Gypsum—do	[e]13	[e]13	15
Iron and steel semimanufactures[e]—do	350	350	192
Lime[e]—do	180	180	162
Petroleum refinery products:			
Gasoline—thousand 42-gallon barrels	4,062	[e]3,904	2,809
Jet fuel—do	1,297	[e]1,097	964
Kerosine—do	205	[e]190	206
Distillate fuel oil—do	3,234	[e]3,101	2,432
Residual fuel oil—do	4,833	[e]4,650	4,595
Other:			
Liquefied petroleum gas—do	462	[e]775	531
Unspecified—do	151		
Refinery fuel and losses—do	949	[e]906	1,011
Total—do	15,193	[e]14,623	12,548
Salt[e]—thousand metric tons	35	35	35
OMAN			
Gas, natural:			
Gross production—million cubic feet	[r]123,516	137,323	139,868
Marketed production—do	[r]2,373	3,806	4,745
Petroleum, crude—thousand 42-gallon barrels	124,600	133,795	123,626
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN			
Petroleum refinery products:			
Gasoline—do	1,343	845	[e]1,440
Jet fuel—do	1,176	1,169	[e]1,171
Kerosine—do	760	779	[e]1,085

See footnotes at end of table.

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Table 1.—Other Countries of the Near East: Production of mineral commodities —Continued

Area, commodity, and unit of measure	1975	1976	1977[p]
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN —Continued			
Petroleum refinery products —Continued			
Distillate fuel oil ---- thousand 42-gallon barrels	2,268	2,808	[e]2,922
Residual fuel oil ---- do	4,835	6,019	[e]6,114
Other ---- do	592	765	[e]860
Refinery fuel and losses ---- do	859	772	[e]802
Total ---- do	11,833	13,157	[e]14,394
Salt[e] ---- thousand metric tons	75	75	75
QATAR[1]			
Cement, hydraulic ---- do	164	172	[e]170
Gas, natural:			
Gross production ---- million cubic feet	192,005	167,038	151,499
Marketed production[3] ---- do	78,010	52,124	56,750
Petroleum:			
Crude ---- thousand 42-gallon barrels	159,482	181,644	162,316
Refinery products:			
Gasoline ---- do	550	671	764
Jet fuel ---- do	229	382	449
Kerosine ---- do	36	39	36
Distillate fuel oil ---- do	519	840	* 927
Residual fuel oil ---- do	17	--	--
Other ---- do	2	46	61
Refinery fuel and losses ---- do	99	30	362
Total ---- do	1,452	2,008	2,599
SYRIAN ARAB REPUBLIC			
Asphalt, natural ---- thousand tons	NA	125	99
Cement, hydraulic ---- do	[r]994	1,110	1,395
Fertilizer materials:			
Crude, phosphate rock ---- do	857	511	425
Manufactured, nitrogenous, N content ---- do	26	26	[e]26
Gas, natural:			
Gross production[e] ---- million cubic feet	58,000	61,000	65,000
Marketed production ---- do	7,396	7,800	[e]8,300
Gypsum ---- thousand tons	[e] [r]60,000	62,496	85,643
Iron and steel semimanufactures ---- do	NA	NA	[e]85
Petroleum:			
Crude ---- thousand 42-gallon barrels	65,930	69,685	63,620
Refinery products:			
Gasoline ---- do	2,915	3,434	4,599
Kerosine and jet fuel ---- do	2,899	2,920	2,993
Distillate fuel oil ---- do	4,692	5,282	8,067
Residual fuel oil ---- do	5,508	7,273	9,125
Other:			
Liquefied petroleum gas ---- do	302	244	365
Asphalt ---- do	515	673	1,022
Refinery fuels and losses ---- do	841	1,288	1,570
Total ---- do	17,672	21,114	27,741
Salt ---- thousand metric tons	33	54	106
Stone, sand and gravel:			
Stone:			
Dimension stone, marble ---- cubic meters	NA	NA	57,063
Other ---- thousand cubic meters	NA	NA	985
Sand and gravel ---- do	NA	NA	4,567
YEMEN ARAB REPUBLIC[1]			
Cement ---- thousand metric tons	[e]50	[e]60	60
Salt[e] ---- do	50	100	200

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, crude construction materials such as common clays, stone, and sand and gravel presumably are produced, but output is not recorded quantitatively, and information is inadequate for formulation of estimates of output levels.

[2]Produces 150,000 cubic meters.

[3]Includes gas reinjected reservoirs, if any.

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Table 2.—Bahrain: Foreign trade of crude petroleum and petroleum refinery products

(Thousand 42-gallon barrels)

Commodity	1975	1976	1977
EXPORTS			
Petroleum refinery products:			
Gasoline	8,966	8,753	8,817
Jet fuel	7,148	8,064	11,734
Kerosine	2,922	5,236	3,202
Distillate fuel oil	18,753	18,993	23,047
Residual fuel oil	26,730	26,976	31,721
Lubricants	--	--	262
Other, including naphtha	--	9,348	10,304
Total	64,519	77,370	89,087
BUNKER LOADINGS			
Petroleum refinery products:			
Distillate fuel oil	836	NA	3,362
Residual fuel oil	3,443	NA	NA
Total	4,279	NA	NA
IMPORTS			
Crude petroleum	55,423	77,102	73,233
Petroleum refinery products:			
Kerosine	--	7	--
Lubricants	5	78	7
Other	--	564	348
Total	5	649	355

NA Not available.

JORDAN[3]

Jordan's gross national product (GNP) increased from $1.5 billion[4] in 1976 to approximately $1.8 billion in 1977, with the contribution of the mineral sector remaining unchanged at 15%. The economy continued to suffer from a growing balance-of-trade deficit, an inflation rate estimated at 14%, a large external debt, and slow industrial expansion. Under the current 5-year plan (1976-80), which scheduled a total expenditure of $2.4 billion, 25% of the plan's allocations was to be invested in the industrial and mineral sector. In 1977, phosphate mining and cement production were the only major industries based on local mineral deposits. Under the 5-year plan, the expansion of phosphate operations was to provide the basis for a domestic fertilizer industry. Other projects included production of potash from the Dead Sea and doubling of production of cement and refined petroleum products. Potential commercial deposits of copper, manganese, uranium, and vanadium were to be further explored and studied.

The Jordanian Government maintained an important equity position in most mineral enterprises and usually acquired a majority interest in new mineral ventures. Recent laws and a new investment code sought to encourage foreign investment, both public and private, in the mineral and industrial sector. In 1977, new investment guarantees were issued, exchange controls were eased, and restrictions on the import of raw materials were removed.

Infrastructure development was to aid in mineral development. Under the 5-year plan, approximately $40 million was to be spent to expand and improve Jordan's rail system. Projects included rehabilitation of a 25-kilometer link between phosphate deposits at El Hasa and Menzil, a 200-kilometer rail line to ship potash from the Dead Sea to the port of Aqaba, and a 150-kilometer railroad from El Hasa to Amman. A major electric power station, which was to be the country's largest, was to be built at Aqaba. The $30 million installation was to have three steam-powered turbine generators with a total capacity of 120 megawatts.

Jordan's phosphate production remained

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at the 1976 level of 1.8 million tons. Exports increased from 1.65 million tons in 1976 to 1.7 million tons in 1977, going to the following destinations: Asia 58%, Eastern Europe 27%, and Western Europe 14%. However, revenues from phosphate sales decreased from $55 million in 1976 to $49 million in 1977, owing to lower world phosphate prices.

Under the 5-year plan, phosphate production capacity was to be increased from 2 million tons to 6 million tons per year by 1980. Jordan Phosphate Mines Co. Ltd., in which the Government held 82%, operated two major mines: The El Hasa mine, 200 kilometers north of Aqaba, and the Ruseifa mine, 15 kilometers northeast of Amman. Production was to be increased at El Hasa from 1.2 million tons to 2.4 million tons per year from the opencast mine, and a 1.8-million-ton-per-year underground operation was to be developed at that location. A smaller expansion project was scheduled at Ruseifa to increase production capacity from 800,000 tons to 1 million tons per year. Development continued on a third mine at Shidiyah, 130 kilometers northeast of Aqaba. Jordan's phosphate reserves were estimated at 2.5 billion tons.

In 1977, Jordan Phosphate Mines ordered technical equipment for analyzing the uranium and vanadium content of Jordan's phosphate deposits. It was estimated that Jordan had reserves of 200,000 to 300,000 tons of uranium and nearly 1 million tons of vanadium associated with phosphate rock. Discussions were in progress with foreign firms regarding the recovery of uranium from phosphoric acid as a byproduct of fertilizer manufacture.

Jordan Fertilizer Industry Co. continued to seek financing for its planned $325 million phosphate fertilizer complex in Aqaba. In 1977, Mitsui & Co. Ltd., Inc. (Japan) was contracted to provide technical and management services for the chemical fertilizer plant. Construction was to be by Spie-Batignolles S.A. (France) and Badger Co., Inc. (United States) under contracts concluded in 1976. Site clearance began for the complex, which was to produce 1,800 tons per day of sulfuric acid, 1,000 tons per day of phosphoric acid, and 2,000 tons per day of monoammonium and diammonium phosphate. After the withdrawal of Agrico Chemical Co. (United States) in 1976, shareholders in the project were the Jordanian Government (52%), the Jordan Phosphate Mines Co. (25%), International Finance Corp. (5%), and private interests (18%). The Jordanian Government was in the process of seeking additional financial partners. In 1977, loans for the fertilizer project had been received from France ($50 million), Abu Dhabi ($30 million), Kuwait ($25 million), and Libya ($20 million).

Arab Potash Co. awarded Jacobs Engineering Co. (United States) a $425 million contract for construction of its Dead Sea potash project. Arab Potash was owned 51% by the Jordanian Government, 25% by Arab Mining Co., 15% by the Saudi-based Arab Investment Co., and 9% by private interests. The project was to process carnallite, produced by solar evaporation of Dead Sea brines, to yield 1 million tons of potash per year. Production was to begin in 1981 and increase to 1.2 million tons per year by 1984 and 10.7 million tons per year by 1990. Reserves of potash in Dead Sea waters were conservatively estimated at 2 billion tons. Facilities were to include some 25,000 acres of dyked solar evaporation ponds at the southern end of the Dead Sea, a 10-kilometer canal linking the ponds to the processing plant, a 15-megawatt powerplant, and a new town to house 2,800 project and operating personnel. Other infrastructure included new access roads and an improved highway system linking the potash project with Amman (80 kilometers north) and Aqaba (200 kilometers south). The potash was to be initially transported by truck to Aqaba where a new shiploading facility of 50,000-ton capacity was under construction. At yearend, Arab Potash was seeking financing from the International Bank for Reconstruction and Development (IBAD), the Agency for International Development (AID), and Arab States.

The Jordanian Cement Co., which operated Jordan's only cement plant near Amman, produced approximately 566,000 tons of cement in 1977. Expansion was underway to increase capacity from 600,000 tons to 1.2 million tons per year by 1979 through the addition of a new dry-process kiln. The cement plant used raw materials quarried in the Amman area. Gypsum production from the Zarqa River gypsum deposit averaged 22,000 tons per year and was under the direction of Public Mining Co. Jordanian-Syrian Industrial Co. continued its feasibility study on construction of a 1-million-ton-per-year cement plant in southern Jordan.

The Mahiş kaolin mine, located near

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Amman, produced approximately 6,000 tons of clay for use in the Amman ceramics factory. Feasibility studies were in progress on the construction of a plant to manufacture sheet glass and glass containers based on deposits of glass sand in the Aqaba area. Jordan also quarried marble and produced about 30,000 tons of salt per year for local consumption.

The Jordanian Natural Resources Authority contracted Seltrust Engineering Ltd. to conduct a feasibility study on exploitation of the Wadi Araba copper deposits. Reserves were estimated at 65 million tons of 1.3% copper ore. The Wadi Araba region also contained proven reserves of 1.5 million tons of manganese ore with estimated reserves of 5 million tons. Manganese prospecting was being conducted under the auspices of the Bureau de Recherches Géologiques et Minières (BRGM).

The only petroleum exploration carried out in Jordan in 1977 was by a group composed of Cie. Française des Pétroles (CFP) (37.5%), Fuyo Petroleum Development Corp. (37.5%), and Filon Exploration Corp. (25%). CFP and Fuyo Corp. acquired their 37.5% holdings in the production-sharing agreement awarded to Filon in April 1975. Their 30-year concession covered an 8,000-square-kilometer area on the eastern bank of the northern Jordan River. The group planned to spud a wildcat well near Ramtha, 90 kilometers north of Amman near the Syrian border; later, the group planned to drill on the eastern shore of the Dead Sea. The consortium was to bear all exploration and development costs and receive 35% of production revenues in the case of commercial discovery.

The Zarqa refinery, situated 25 kilometers from Amman, processed about 24,000 barrels per day of petroleum in 1977. Approximately 300,000 barrels of petroleum products was exported to Lebanon and Syria, with the remainder consumed locally. Crude oil was imported from Saudi Arabia by way of the Trans-Arabian Pipeline TAPline, although the question of Jordan's outstanding debt to TAPline for petroleum shipments remained unresolved. Construction work continued on the expansion project designed to raise the refinery's production capacity to 60,000 barrels per day by 1978. In 1977, the refinery's lubricating oil blending and canning plant was completed and commissioned. At yearend, Jordan Petroleum Refinery Co. Ltd. signed a $100 million loan agreement with a group of international banks to help meet financial commitments stemming from the expansion project.

Table 3.—Jordan: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal destinations, 1976
METALS			
Aluminum, unwrought and semimanufactures	282	368	Mainly to Syria.
Copper matte	163	99	All to Syria.
Iron and steel:			
Scrap	1,737	4,783	Turkey 2,699; Iraq 1,127; Syria 635.
Semimanufactures	819	8,634	Saudi Arabia 8,607.
Lead metal including alloys, all forms	910	560	Egypt 315; Saudi Arabia 129; Syria 116.
Zinc metal including alloys, all forms	50	370	Saudi Arabia 230; Syria 140.
NONMETALS			
Cement	73,458	2,089	Saudia Arabia 1,700; Syria 388.
Clays and clay products: Crude clays	35	--	
Fertilizer materials:			
Crude, phosphatic	1,111,877	1,653,244	NA.
Manufactured, nitrogenous	45	356	Lebanon 353.
Lime	145	143	All to Saudi Arabia.
Salt	--	2,948	Lebanon 2,438; Qatar 365.
Stone, sand and gravel:			
Dimension stone, crude and partly worked:			
Calcareous	44,380	54,924	Syria 42,388.
Other	4,470	15,194	Kuwait 13,038; Saudi Arabia 1,989.
Crushed stone and gravel	1,422	--	
Sand	80	720	Saudi Arabia 661.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen	8,271	9,190	Syria 5,103; Saudi Arabia 2,681; Iraq 1,369.
Coke and semicoke	45	99	All to Saudi Arabia.
Petroleum:			
Distillate ---- thousand 42-gallon barrels	37	2	Mainly to Syria.
Residual ---- do	--	105	Syria 98; Lebanon 6.
Liquefied petroleum gas ---- do	36	90	Syria 59; Lebanon 30.
Other, n.e.s ---- do	3	3	Netherlands 1; Saudi Arabia 1.

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Table 4.—Jordan: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976	Principal sources, 1977
METALS			
Aluminum metal including alloys, all forms	1,186	2,225	Hong Kong 608; Greece 564; Lebanon 414.
Copper metal including alloys, all forms	87	353	Italy 180; Japan 67.
Iron and Steel:			
Scrap	1,722	2,469	Kuwait 2,425.
Pig iron, ferroalloys, similar materials	13,401	10,030	Republic of South Africa 10,000.
Steel, primary forms	24,196	87,678	Republic of South Africa 51,340; Australia 16,499; India 9,975; Japan 9,864.
Semimanufactures	65,277	116,042	Japan 21,099; India 16,225; Czechoslovakia 11,617.
Lead:			
Oxides	271	37	All from West Germany.
Metal including alloys, all forms	1,760	3,176	Saudi Arabia 1,773; Kuwait 1,076.
Manganese oxides	120	--	
Tin metal including alloys, all forms	10	9	West Germany 5; United Kingdom 4.
Titanium oxides	104	1,153	Italy 760; Taiwan 250.
Zinc:			
Oxides	88	104	West Germany 100.
Metal including alloys, all forms	129	428	Belgium 304; Kuwait 80.
Other metals: Base metals including alloys, all forms, n.e.s	21	25	Turkey 20; France 4.
NONMETALS			
Abrasives, natural, grinding and polishing wheels and stones	100	114	Italy 60; West Germany 24.
Cement	7,909	134,978	Turkey 28,863; Spain 27,505; Romania 24,696; Cyprus 14,008.
Chalk	349	1,941	United Kingdom 839; Belgium-Luxembourg 544; France 261; Greece 200.
Clay products:			
Refractory	926	1,090	China 906; West Germany 161.
Nonrefractory	2,390	7,486	Italy 2,303; Spain 1,729; Czechoslovakia 856.
Feldspar and fluorspar	--	626	West Germany 206; Italy 200; Japan 200.
Fertilizer materials, crude and manufactured:			
Nitrogenous	1,107	15,168	Italy 7,660: Norway 2,000; Kuwait 1,407; Austria 1,200; West Germany 1,186.
Phosphatic	4,385	3,375	Lebanon 1,800; Austria 900; Belgium-Luxembourg 500.
Potassic	961	4,425	Italy 2,710; Belgium-Luxembourg 499; Japan 448.
Other, n.e.s	5,855	987	Kuwait 875.
Gypsum	690	6,292	Syria 5,769.
Pigments, manufactured	--	115	West Germany 67; India 19; Spain 12.
Lime	1,865	1,263	Lebanon 889; Turkey 374.
Magnesite	10	--	
Salt	--	250	Kuwait 170; United Kingdom 54.
Sodium and potassium compounds:			
Caustic potash, sodic or potassic peroxides	385	301	Italy 278.
Caustic soda	608	1,116	Lebanon 379; Spain 250; Syria 207; Kuwait 101.
Soda ash	440	704	Syria 184; Turkey 106; Romania 100; France 75; Japan 70.
Stone, sand and gravel: Dimension stone, marble	4,236	8,179	Italy 6,716.
Sulfur:			
Elemental	1,012	1,051	Kuwait 766; France 197; West Germany 84.
Sulfuric acid	3,846	3,782	Iraq 2,051; Kuwait 1,652.
Asphalt and bitumen, natural	432	--	
Carbon black	36	--	
Coke and semicoke	429	408	West Germany 222; Lebanon 186.
Fuel briquets, all forms	--	241	West Germany 151; Belgium-Luxembourg 65; France 25.
Hydrogen, helium, rare gases	78	67	Kuwait 19; France 15; Italy 15; Turkey 10.
Petroleum:			
Crude thousand 42-gallon barrels	6,313	8,575	All from Saudi Arabia.
Refinery products:			
Gasoline	2	3	Saudi Arabia 2.
Kerosine	r3	--	
Lubricants	69	92	Netherlands 37; United States 14; Belgium-Luxembourg 10; United Kingdom 8.
Other, n.e.s	1	2	Belgium-Luxembourg 1.
Total	r75	97	

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LEBANON[5]

In 1977, Lebanon gave priority to economic reconstruction after the extensive damage suffered in the civil conflict of 1975-76. Less than 5% of the gross national product (GNP) was derived from the mineral sector, which consisted primarily of cement manufacture and petroleum refining. The economy was based largely on the services sector, specifically banking, commerce, and tourism. The Board for Reconstruction and Development focused its efforts on reviving the financial center of Beirut and rebuilding the country's infrastructure. A $150 million[6] loan was received from several Western European countries for infrastructure development, and a $35 million loan was received from the European Investment Bank to finance power projects. The port of Beirut, previously one of the busiest trading centers in the Middle East, was being reconstructed and was opened to limited shipping in December 1976. The northern port of Tripoli was also to undergo repairs and expansion in 1978.

Lebanon reached an agreement with Saudi Arabia in 1977 whereby the latter would assume Lebanon's debts, estimated at $123 million for previous imports of crude oil. In 1977, Lebanon imported Saudi Arabian light crude for processing in its two refineries at a delivered price of $12.68 per barrel. The Tripoli refinery, which was nationalized in 1976 after the closure of the Iraq National Oil Company (INOC) pipeline, was operating at a near normal level after being reopened in May 1977. The 30,000-barrel-per-day refinery processed approximately 6.6 million barrels of petroleum during the year. At yearend, the Lebanese Government concluded an agreement with TAPline for deliveries of crude at a price of $13.29 per barrel for 1978.

Lebanon's other refinery at Zahrani, just south of Sidon, operated at much less than its 17,500-barrel-per-day capacity in 1977. Also supplied by deliveries of Saudi crude over TAPline, the refinery produced about 3.3 million barrels of petroleum products during the year. Although owned by the Mediterranean Refining Co. (Medreco), which in turn was owned by CALTEX and Mobil Oil Corp., the refinery was taken under Government sequestration in 1973 following a price dispute with TAPline. In 1978, TAPline was to supply crude oil to the Medreco refinery at a price of $13.10 per barrel.

In 1977, Lebanese Pipeline Co., owned 51% by the Lebanese Government, was considering the construction of a petroleum pipeline to link Beirut with the refineries at Tripoli and Sidon. The 150-kilometer pipeline was to cost about $30 million and be completed by 1979.

Lebanon produced approximately 1.4 million tons of cement in 1977 at its three cement plants located at Chekka, South of Tripoli. The Soc des Ciments Libanais plant was to be expanded from 1.2 million tons to 1.8 million tons per year by 1979. Also, the Soc Libanaise des Ciments plant was to be expanded from 50,000 tons to 160,000 tons per year, also by 1979. A 450,000-ton-per-year plant was operated by Cimenterie Nationale S.A.L. The three plants used gypsum and limestone quarried near Tripoli.

The triple superphosphate plant owned by Lebanon Chemicals Co. began limited production in mid-1977 after being closed during the 1976 disturbances. The plant had an annual production capacity of 100,000 tons of fertilizer. Phosphate rock was imported from Syria.

OMAN[7]

The prospects for halting Oman's declining oil production were brighter in 1977 because of new oil discoveries in the southern Dhofar Province. Petroleum production reached a peak in 1976 and started to decline in 1977. Overall petroleum reserves previously expected to be depleted in about 20 years unless significant new deposits were found. Oman's Government was turning its attention to revenue-generating projects such as copper, cement, and steel plants, although nothing was expected to entirely compensate for the expected drop in oil exports. Petroleum was Oman's most significant foreign exchange earner, contributing 64% to the 1977 Government revenues of $2,098 million.[8] Loans and grants during 1977 totaled $645 million, representing mostly Saudi Arabia and Abu Dhabi capital. These funds included specific loans for new Dhofar petroleum development, and for the Sohar copper project.

The Oman Development Bank was formally incorporated on December 18, 1977. The major shareholders included the Government of Oman (40%); Kuwait Trading,

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Contracting and Development Co. (10%); Arab Bank Ltd. (5%); Hong Kong & Shanghai Banking Corp. (5%); the National Bank of Oman (2%); The Chartered Bank, Muscat (1%); and Grindlays Bank Ltd. (1%). The new bank will operate in all fields of development, including oil.[9]

The Government places few restrictions on the operation of foreign companies. For most companies (except banks and specifically exempted organizations), the Omani share of capital and profits was to be not less than 35%. Company income tax started at 20% of net profits, but if the Omani share of capital and profits was at least 51%, the income tax rate began at 15%. Tax holidays of 5 years were available for firms engaged in industrial development. There were no personal income taxes. Oman is eligible for the U.S. General System of Preferences (GSP) tariff law for its exports to the United States, but exports other than petroleum are practically nonexistent. Duty-free importation of raw materials to companies in basic industrial sectors such as cement is also available. In order to decrease Oman's dependence upon oil, diversification of the economy toward other minerals and light industry was being encouraged by the 1976-80 5-year plan. Investment prospects are limited by a shortage of skilled labor and by the need to import most goods.

For the first time since 1973, Oman achieved a balance-of-trade surplus in 1977. In value, exports (over 99% petroleum) remained at 1976 levels, although in quantity, petroleum exports actually fell from the record high of 134.4 million barrels in 1976 to 122.0 million barrels in 1977. Over 50% of Oman's crude oil exports in 1977 went to Japan. Other importers included the United States (15.4%), the Netherlands (9.1%), Curaçao (9.1%), France (3.8%), Sweden (3.4%), and Norway (3.1%). The United Kingdom, Italy, the Federal Republic of Germany, Portugal, and the Ivory Coast all imported 1% or less of Oman crude. Imports also remained similar to those of 1976 in value, estimated at $1,058.5 million in 1977. In the first 6 months of 1977, Oman imported a total of 4.5 million barrels of refined petroleum products from Iran (78%), Bahrain (7%), Saudi Arabia (2.6%), and Kuwait (1%). Total refined petroleum imports for 1977 were valued at $60 million.

The Omani Government was planning a 30,000-barrel-per-day oil refinery for internal use near the tanker-loading facility at Mina al Fahal. The feasibility study was being done by Shell Oil Co., and the project was expected to cost $130 million. Several United States, Western European, and Japanese firms had made inquiries.

Petroleum production from the northern fields averaged 339,000 barrels per day in 1977, but was expected to fall to around 219,000 barrels per day by 1981. In early 1977, the Oman Government set oil prices at a new buy-back price of $12.72 per barrel of 34° API gravity crude, which was a 7.3% rise over the market price at yearend 1976 and a 9% rise over the official buy-back price of $11.67 per barrel. The Government decided to maintain an official selling price for 34° API gravity crude of $13.00 per barrel for January 1978.

Petroleum exploration was active in 1977 in both northern and southern areas. In the western Butabul region near the Saudi border, Wintershall Aktiengellschaft of the Federal Republic of Germany had acquired a 20% interest in the Elf-Aquitaine/Sumitomo Petroleum Development Co., Ltd., (Japan) venture. Elf-Aquitaine (60%) and Sumitomo (40%) acquired the 7,000-square-kilometer tract under a production-sharing agreement in May 1975. Elf-Oman, the operator, completed seismic surveys and planned to drill the first deep exploration well in February 1978. Two U.S. companies, Gulf Oil and Quintana, were exploring an onshore concession at Sunaina near the United Arab Emirates border. Quintana was to be the operator. The West German firm Deminex AG (Federal Republic of Germany), Agip S.p.A. (Italy), and British Petroleum Co. Ltd. (BP) signed a concession agreement in Dhofar in late 1977. The consortium was obligated to spend about $40 million on exploration and development in a 64,000-square-kilometer Dhofar concession.

A new petroleum discovery, 20 kilometers west of Amal at Qahira, was described as encouraging and was expected to produce a lighter crude (30° API gravity) than the Amal-Marmur crude (20° to 24° API gravity and high (3% to 4%) sulfur). This discovery allowed Petroleum Development (Oman) Ltd. (PDO) to revise its plans for transporting oil from the Dhofar Province. PDO planned to build a 500-kilometer, crude oil pipeline from Dhofar Province to the existing export terminal at Mina al Fahal, instead of to Salalah in southern Oman as originally planned. This pipeline would be

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used in the development of the Marmur and Amal fields having initial capacities of 20,000 barrels and 10,000 barrels per day, respectively. Up to 70 development wells were to be drilled by 1980 at Dhofar. The new Dhofar Fields production was to be used to partially offset falling output from the northern fields, expected to decline at a rate of about 10% per year.

Natural gas reserves were estimated at 240 billion cubic meters. Gas was being produced commercially at the rate of 48 million cubic meters per year, but the greater part was still being flared. A natural gas pipeline was under construction that was to conduct gas from the Yibal oilfields to the Ghubra area power station, a distance of 320 kilometers. The gas was to be used at Ghubra for electric power and desalination plants, and for industry. A spur of the pipeline was to be laid to Sohar for the planned copper project. A natural gas liquids (NGL) plant was under construction at Yibal and was to be onstream by late 1978. PDO was also building a smaller NGL plant at the Saih Rawal Field that would produce 1,100 barrels per day of light oil. This plant, which utilized a new French thermal cooling process, came onstream at yearend 1977.

An asbestos cement pipe factory was completed by Amiantit-Oman Co. in the Industrial zone at Rusayl, 20 kilometers inland from Seeb, and began production in 1977. Operated as a joint venture by Amianti of Switzerland and Bahwan, an Omani firm, the rated capacity of the plant was 36,000 tons per year. Oman Cement Co., owned 40% by Kuwait Cement Co. and 60% by the Omani Government, was planning to construct a cement factory and packing plant in the Barka industrial zone near Muscat. The plant was to cost about $210 million to construct and would have an eventual capacity of 1 million tons per year. Production was planned for 1980, when about 40% of the plant output was to be exported as clinker to Kuwait. The rest was to satisfy internal needs. A new port near Barka, 60 miles north of Muscat, was to be built to handle the cement trade.

Oman Mining Co., owned 75% by the Omani Government and 25% by Marshall Oman Exploration Co. and Prospection Ltd. of Canada, was starting to develop four northern copper deposits, which together were estimated to contain 20 million tons of 2% copper ore. Saudi Arabia had agreed to lend $100 million of the total $120 million to $140 million needed for development of the mines, a concentrator, and a small local smelter. A new port facility, housing, and roads, as well as a 200-kilometer gas pipeline from Ghubra in the capital area to Sohar for a 30-megawatt powerplant and smelter fuel, were also to be built. The complex would employ 400 to 500 persons. Production was scheduled for startup in 1980, at which time 20,000 tons of refined copper was to be produced per year. Roughly 3,500 tons of ore was to be processed per day.

In addition to the copper sites described above, which were located 50 kilometers from Sohar along the Wadi Jizzi, other deposits were reported. About 4 million tons of copper ore was reported at Rakah, located on the southern side of the Jebel Akhdar mountain; other small deposits were located at Sharquiya, near Rostag, and near the United Arab Emirates border.

The Omani Government was planning to build a steel-rolling mill and was negotiating with several companies for its construction. The mill would produce 120,000 tons per year of reinforcing bars, using 100-millimeter-square billets as feedstock. Associated with the mill, the Government was proposing a gas-fired, 400,000-ton-per-year, direct-reduction plant that would use 600,000 tons of imported iron ore pellets per year, and a 200,000-ton-per-year electric steel plant using some of the resultant sponge iron.[10]

Other mineral deposits under consideration for development included chromite (5 to 10 million tons), asbestos (9 million tons), anthracite (10 million tons), and large deposits of limestone. Phosphate rock and small copper deposits were reported in southern Dhofar Province. There were also indications of magnesium, nickel, and iron deposits. Several Western European firms were showing interest in development of the asbestos, which was probably chrysotile. A West German economic and trade delegation visited Oman in late 1977. The most immediate interest was the petroleum and minerals sector. The Federal Republic of Germany was interested in following up on a preliminary survey made by a fact-finding group in April 1976 and early 1977 on minerals of Dhofar Province, as well as in northern Oman. Metallgesellschaft AG also discussed copper and chromite mining participation and the planned steel-rerolling mill.

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QATAR[11]

Petroleum revenues accounted for over 70% of Qatar's 1977 gross national product (GNP), estimated at $3 billion[12] at current prices. With petroleum reserves expected to last at least 25 years and natural gas reserves potentially for hundreds of years, Qatar was making plans for rapid-pace development. Projects for establishing direct-reduction steelworks, petrochemical and NGL plants, and additional cement capacity were already in progress. Crude oil production was limited to a level sufficient to provide funds to proceed with industrial development, but was planned to start a gradual decline by the second half of the 1980's. The Government's production conservation policy set a ceiling of about 500,000 barrels per day. Qatar is a member of the Organization of Petroleum Exporting Countries (OPEC) as well as OAPEC.

In late 1976, the Government of Qatar became the owner of the Qatar Petroleum Co. Ltd. (QPC) in Dukhan, and in 1977, it completed nationalization with 100% acquisition of Shell Co. of Qatar Ltd. (SCQ). Qatar General Petroleum Corp. (QGPC) controlled marketing, and the Qatar Petroleum Producing Authority (QPPA) was formed in 1977 to regulate production. Qatar's oil production came from two main areas, one onshore at Dukhan, and the other a cluster of three offshore fields east of the Qatari peninsula. Both QPC and SCQ formed service companies to carry out management services under contract with QPPA. Dukhan Service Co. Ltd. (DSC), owned by QPC, was to operate the onshore areas at Dukhan, while Qatar Shell Services Co. (QSSC), owned by Shell (80%) and Italy's Ente Nazionale Idrocarburi (ENI) (20%), would continue to operate the offshore fields. Qatar was also entitled to one-half of the petroleum production from the Al Bunduq Field, shared with Abu Dhabi and operated by Al-Bunduq Oil Co., which was owned by British Petroleum (33-1/3%), Compagnie Française des Petroles (33-1/3%), and Petroleum Development Company of Japan (33-1/3%).

Crude petroleum production in 1977 was 162.3 million barrels, down about 10% from that of 1976. QPPA averaged a total of 435,145 barrels per day from both onshore and offshore fields. In addition, Qatar's 1977 share of production from the offshore El Bunduq Field, which straddles the border between Qatar and Abu Dhabi, amounted to an average of 9,476 barrels per day. The total El Bunduq output of 18,950 barrels per day was down 7.4% from that of 1976; this was attributed to technical problems arising in the latter part of 1977.[13]

In 1977, petroleum exports were 149.8 million barrels valued at $2.2 billion. Of this, 82.9 million barrels was shipped from Halul Island, and the rest, from Umm Sa'id.[14] The Government held crude oil sales contracts with the shareholders of QPC and SCQ, as well as with Charter Oil Co., Petrofina S.A. (Belgium-Luxembourg), Gulf, Sumitomo (Japan), and Union Rheinische Braunkohlen Kraftstoff AG (Federal Republic of Germany). Total 1977 imports were valued at $1.3 billion, of which 50% came from the United Kingdom, Japan, the United States, and the Federal Republic of Germany. Imports from the United States increased from $16 million in 1972 to over $111.9 million in 1977, 10.5% of Qatar's total imports.[15]

All onshore oil came from the Dukhan Field, located on the western side of the Qatari peninsula. The 2,000-square-kilometer area had the potential to produce 280,000 barrels per day from three main areas—Khatiyah, Fahahil, and Jaleha—but in 1977 produced an average of only 200,274 barrels per day. Steady increases in field production have been assisted by secondary recovery methods (such as water flooding). The Dukhan Field had 94 wells, of which 60 were oil producers, 4 gas producers, and the rest shutin or water wells.[16] Offshore production came from three fields and had been as high as 370,000 barrels per day. Idd el-Shargi had 15 wells with a 1977 production of around 10,600 barrels per day; Maydan Mahzam had 11 wells, with a 1977 production of around 99,000 barrels per day; and farther east, Bul Hanine had 7 wells and was the most productive of the three with about 125,400 barrels per day in 1977.

Holcar Oil, an independent U.S. company, was exploring for petroleum in an 8,700-square-kilometer area off the eastern coast of Qatar. Wintershall, operator for the offshore concession to the northeast of the peninsula, was planning to spend $8 million on exploration for petroleum and natural gas in 1978. The Wintershall Group also

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included Koch Oil International Co. of the United States, Veba-Chemie AG and Deutsche Schachtbau-und Tiefbohrgesellschaft mbH of the Federal Republic of Germany, and Gulfstream Resources Ltd. of Canada. Both companies were exploring under a production-sharing contract.

Acting through QPPA, the Qatari State company QGPC initiated an extensive, $7 million seismic evaluation of the entire North-West Dome exploration area. Located in Permian Khuff strata to the northeast of the peninsula, this 2,000-square-kilometer area was the site of the major natural gas discovery of mid-1976 by SCQ. The Qatar Gas Co., owned 70% by QGPC and 30% by Shell, was commissioned to do the feasibility study of a liquefied natural gas (LNG) export industry using North-West Dome gas.

The North-West Dome Field was being operated by QCS on a contract basis. The Permian Khuff gas reservoir development was to take place in three stages. The first involved developing five wells to produce 200 million cubic feet per day; two more wells in the second stage would boost production to 300 million cubic feet per day; the third and final stage included plans for seven additional wells, which would bring final production to 700 million cubic feet per day.

Onshore, QPPA produced 245 million cubic feet per day of associated and unassociated gas from wells of the Dukhan field. Marketed natural gas during 1977 was 148.6 million cubic feet per day, compared with 124.3 million cubic feet per day in 1976.[17] About 170 million cubic feet per day of natural gas continued to be flared from offshore fields, pending completion of gas utilization projects. Natural gas reserves were estimated to range from 30 trillion cubic feet to as high as 100 trillion cubic feet, including those in the North-West Dome field.

There were two NGL plants under construction at Umm Sa'id. Construction was started on NGL-II in early 1977 and was expected to be completed by mid-1979. Production of offshore associated gas at NGL-II would include 1,100 tons per day of propane, 900 tons per day of butane, and 900 tons per day of pentane. By yearend, construction of a new NGL-I plant had started to replace the plant that was destroyed in a fire accident in April 1977. When completed in 1980, the new NGL-I will produce 1,200 tons per day of propane, 750 tons per day of butane, and 450 tons per day of natural gasoline from onshore associated gases. A 1,200-billion-cubic-foot-per-year LNG project, expected to cost $3 billion, was under study.

Qatar Fertilizer Co. (QAFCO), owned 70% by the Government, 25% by Norsk Hydro A/S, 3% by the British Davy Powergas Co., and 2% by Hambros Bank Ltd., completed the QAFCO-I plant in 1973 and started work on the QAFCO-II project in 1975. QAFCO-II, expected to be completed in 1979, was to double the total production capacity to 1,800 tons per day of ammonia and 2,000 tons per day of urea. Approximately 300,000 tons of nitrogenous fertilizer was produced in 1977.

Qatar Petrochemical Co. (QAPCO) was building a petrochemical complex to produce about 280,000 tons per year of ethylene. Most of this production was to be processed onsite into polyethylene. The partners in QAPCO are the Government (84%) and CdF Chimie of France (16%). Gazocean, which previously had 5% of the project, withdrew, leaving its share to Qatar (4%) and CdF Chimie (1%). QAPCO's polyethylene production was planned for export to neighboring countries and Africa.

Qatar had two petroleum refineries, one with a 700-barrel-per-day capacity and one with a 9,500-barrel-per-day capacity; the latter was under expansion to 15,000 barrels per day. Production at the National Oil Distribution Co. (NODCO) refinery reached at Um Sa'id 2.32 million barrels in 1977, compared with 1.35 million barrels in 1975. Domestic consumption rose from 1.58 million barrels in 1976 to 2.62 million barrels in 1977, necessitating imports to cover the difference. A new refinery to serve mostly local needs was under study and was planned for completion in 1982 with a 50,000- to 80,000-barrel-per-day capacity.

Production from the Qatar Steel Co. (QASCO) direct-reduction steel plant at Umm Sa'id was to start in 1978. A joint venture between the Qatari (70%), Kobe Steel Ltd. (30%), and Tokyo Boeki Ltd. (10%), the steel mill was to have a capacity of 400,000 tons per year, mostly of reinforced steel bars. Approximately 70% of QASCO's bar steel was to be exported to nearby countries such as Saudi Arabia. Imported iron ore and pellets were to come from Australia, Brazil, and Sweden.

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Cement production was to be raised from 300,000 tons to 580,000 tons per year capacity. A fourth cement furnace with a 900-ton-per-day capacity was to be added to the Qatar National Cement Co. Ltd. plant at Umm Bab in 1978. The cement plant at Umm Bab produced both portland and sulfate-resistant cement types. Cement consumption was up 17% in 1977 to 444,500 tons, of which about 270,000 tons was imported.

Table 5.—Qatar: Exports of crude oil, by destination

(Thousand 42-gallon barrels)

Country of destination	1975	1976	1977
Australia	1,789	1,903	3,358
France	11,826	26,242	17,666
Germany, Federal Republic of	7,446	5,453	6,205
Italy	15,659	11,236	10,403
Japan	511	1,464	20,221
Netherlands	27,375	31,000	18,214
Sweden	511	3,038	1,935
Thailand	10,184	16,946	17,557
United Kingdom	20,002	21,191	8,030
United States	32,157	33,233	32,996
Yemen, People's Democratic Republic of	621	2,159	402
Other	28,249	24,231	12,773
Total	156,330	178,096	149,760

Source: Organization of Petroleum Exporting Countries, Statistics Unit, Annual Statistical Bulletin 1977, (Vienna), 1978, p. 72.

Table 6.—Qatar: Imports of petroleum refinery products

(Thousand 42-gallon barrels)

Product	1975	1976	1977
Gasoline	41	--	--
Jet fuel and kerosine	139	--	--
Distillate fuel oil	--	--	--
Lubricants	34	35	28
Other	181	--	--
Total	395	35	28

SYRIA[18]

Syria's mineral industry, based on the production of petroleum and phosphate, contributed about 13% to the 1977 gross domestic product (GDP), estimated at $6.5 billion.[19] Expenditures planned for the current 5-year plan (1976-80) were revised, and the plan was reissued in June 1977. Projects in the mineral sector included intensified petroleum and mineral exploration, expansion of phosphate production capacity, and completion of fertilizer, cement, and petroleum refinery projects already under construction. The plan relied heavily on external financing. In 1977, Syria received a total of $700 million in foreign aid, including $100 million from the United States.

Syria's petroleum production decreased from 70 million barrels in 1976 to 64 million barrels in 1977. Within the Ministry of Petroleum and Mineral Resources, the State-owned Syrian Petroleum Co. (SPC) was responsible for the exploration, production, and marketing of petroleum and petroleum products. Reserves were estimated at 2.2 billion barrels concentrated in five fields in the northeast of the country—Suwaidiyah, Karatchuk, Rumailan, Djubissa, and Olayan. The new Aliane Field came onstream in mid-1977 at an initial rate of 3,500 barrels per day. A 300,000-barrel-per-day-capacity pipeline carried crude oil from the producing fields by way

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of Homs, where a small volume of oil was taken off for refining, to the Tartus export terminal on the Mediterranean Sea. In 1977, Syria exported about 60 million barrels of oil, with 85% going to Western Europe.

The Homs refinery operated at below capacity, which is estimated at 5.4 million tons per year. New desulfurization equipment, which was to enable the refinery to process a mixture of high-sulfur Syrian crude oil with imported light crude, was not yet in operation. The processing modification at the refinery was made necessary by the closure of the Iraq National Oil Co. (INOC) pipeline in April 1976. Iraq previously supplied Syria with over $100 million per year in transit fees, as well as with Iraqi light crude oil for refining at a substantial discount. In 1977, Syria imported approximately 2 million tons of oil from Saudi Arabia. The new refinery under construction at Bâniâs by Romanias' Industrialexport was also to undergo a modification of its refining process from a mixture of 80% Iraqi crude and 20% Syrian crude to a mixture containing 50% Syrian crude. The 6-million-ton-per-year refinery was to begin operation in 1978.

SPC, with technical assistance from the U.S.S.R., located several potential commercial oilfields in the past few years. The Tishreen, Salhié, Gehebeh, Keiba, and Mansoûr Fields, all located in the northeast of the country, were expected to add another 1 million tons to total production by 1980. Syria continued its policy of engaging international firms to assist in petroleum exploration, a significant departure from its earlier program of restricting petroleum development to partnership with the U.S.S.R. and Eastern Europe. The first U.S. group to be granted a concession area, the Tripco consortium, relinquished its acreage in 1976 after unsuccessful results. In 1977, Syria concluded a 25-year, production-sharing agreement with Syrian-American Oil Co. (SAMOCO), a division of Coastal States Gas Producing Co. The concession area covered a 15,750-square-kilometer area in the eastern Deïr-ez-Zor District. Contract provisions included recoverable company costs from 40% of production with the remaining output split 77-23 in favor of the Syrian Government. Syria also signed a production-sharing agreement with the Royal Dutch/Shell Group for a 22,000-square-kilometer area north of Palmyra. Pecten Syria was to act as operator, and minimum exploration outlays were set at $15 million. The only remaining foreign interest was Rompetrol of Romania, which was prospecting on a 9,350-square-kilometer tract in the northeastern part of Syria.

SPC was considering bids received for a $55 million project to gather and process associated gas from the Suwaidiyah, Karatchuk, and Rumaylan oilfields. In 1977, the major part of Syria's natural gas production, estimated at 65 billion cubic feet annually, was flared. The gas-gathering project included pipelines, compressor stations, processing units, and supporting facilities. Production would consist of liquefied petroleum gas (LPG), naphtha, light gas fuel, industrial solvents, and sulfur.

Production of phosphate rock decreased from 511,000 tons in 1976 to 425,000 tons in 1977 owing primarily to low world prices for the commodity. The price for Syrian phosphate rock fell from $53 to $30 per ton, causing output to fall to its lowest level in years. Nevertheless, Syria planned to expand production capacity to 3 million tons per year by 1980. Reserves at the three principal mines, Khunayfis, and Sharqiyah A and B, were estimated at 1 billion tons. Phosphate rock was transported by truck from the mines south of Palmyra to Tartus for export; a 240-kilometer railroad to link the mines with the export terminal was under construction. All of the production was exported, primarily to Romania, Bulgaria, and Czechoslovakia.

Three new fertilizer plants were being constructed under the supervision of the Syrian General Establishment of Chemical Industries (GECI). Syria's single facility at Homs produced approximately 26,000 tons of nitrogenous fertilizer in 1977. The new facilities were to allow Syria to meet all fertilizer needs with excess production for export. Industrialexport was constructing a 1,400-ton-per-day, triple superphosphate plant at Homs and a 1,000-ton-per-day, triple superphosphate plant at Deïr-ez-Zor. The two plants, costing a total of $300 million, were to begin production in 1979. Creusot-Loire (France) was managing contractor for a nitrogenous fertilizer plant under construction at Homs that was to produce 1,000 tons per day of ammonia and 1,050 tons per day of urea.

Exploitation of iron ore deposits in three areas of the country was under consideration by the General Establishment for

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Geology and Mineral Resources. Reserves at deposits northwest of Aleppo, northwest of Damascus, and east of Hama were estimated at 90 million to 100 million tons containing 28% to 32% iron.

Syria's consumption of iron and steel products was predicted to increase from 300,000 tons in 1977 to 800,000 tons in 1980. The General Co. of Iron and Steel Products (GENCOSTEEL) recently expanded its iron and steel complex at Hama and was considering other projects to increase capacity. Three plants were in operation—a cold-rolling mill, producing 110,000 tons of iron rods per year; a metal pipe factory, with a capacity of 20,000 tons per year; and a 120,000-ton-per-year sponge iron smelting factory. Also under consideration were a 150,000-ton-per-year mill to produce galvanized sheet and tin plate, a 400,000-ton-per-year mill to produce bars and sections, and a 500,000-ton-per-year sheet steel unit.

Syria produced approximately 1 million tons of cement in 1977 from local gypsum and limestone deposits. Three plants were under the supervision of the General Organization for Cement. Chahba Cement Co. at Aleppo had a capacity of 580,000 tons per year, Syrian Cement Co. at Hama had a capacity of 460,000 tons per year, and National Co. for Cement at Dummar was rated at 280,000 tons per year. Plans were under consideration for the constructon of a 150,000-ton-per-year plant at Adra and a 200,000-ton-per-year plant at Tartus.

PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN[20]

The mineral sector of the People's Democratic Republic of Yemen, which consisted of the production of salt and the refining of imported crude oil, was a significant factor in the nation's economy. Refined petroleum products, which were exported largely to Western Europe, accounted for about 75% of the total export value. Other income was derived from the export of salt to Africa. The current 5-year plan (1974-78), which scheduled a total expenditure of $225 million,[21] planned an intensification of oil and mineral exploration and the development of industries using local raw materials. Economic development remained largely dependent on foreign funding, and the Government sought to restore diplomatic relations with the United States, which were terminated in 1969.

Nearly 25% of the expenditures in the 5-year plan were allocated to infrastructure development. The largest project was improvements to the port at Aden, which was one of the world's largest oil-bunkering ports prior to the closure of the Suez Canal. In November 1977, a new floating dock was commissioned at Aden. Completed renovation and modernization of the port was expected to cost $18 million. Mukalla, the only other port of significance in the People's Democratic Republic of Yemen, was the center of coastal trade for the eastern part of the country. Negotiations continued with Saudi Arabia regarding the construction of an oil export terminal on the Hadhramaut region's coast to be linked by transpeninsular pipeline to Saudi oilfields.

A grant of $1.8 million was received from the Abu Dhabi Fund for Arab Economic Development (AFAED) to finance mineral exploration. Hunting Geology and Geophysics Ltd. (United Kingdom) was contracted by the Board of Petroleum and Minerals to continue its mineral-prospecting program. The survey focused on copper occurrences in the Maahir-Ghabar area, 50 kilometers northwest of Mukalla, and on heavy minerals in beachsands along the coast. Sampling was conducted to confirm preliminary estimates of ilmenite, zircon, and rutile content of beachsands in five zones. Mineralogical and geochemical laboratories were established in Mukalla for the training of Yemeni personnel.

The refinery, previously owned by BP, was officially nationalized in May 1977. BP Refinery (Aden) Ltd., however, was contracted by the Government to continue management and operation of the refinery. The 160,000-barrel-per-day refinery was reported as operating at 25% of its rated capacity. Crude oil for refining was imported from Qatar, Kuwait, the United Arab Emirates, and other Arab States.

Both the Government and foreign companies continued petroleum prospecting under the supervision of the Board of Petroleum and Minerals. The Government centered its efforts on the Ras Fartak and Thamud regions. Siebens Oil & Gas Ltd. (Canada) drilled two wildcat wells in its 17,553-square-kilometer concession area in south

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ern Socotra Island and its offshore area. The Soviet firm Technoexport continued exploration in its 10,000-square-kilometer tract of the Thamud area. In 1977, a new production-sharing agreement covering offshore waters of the eastern coast was concluded with Agip.

Salt production at the State-owned General Salt Organization facilities at Khawr Maksoir near Aden was approximately 75,000 tons per year. The production of unrefined marine salt from the evaporation of seawater employed approximately 100 workers. Work continued through 1977 on the reconstruction of a salt factory to have a capacity of 100,000 tons per year.

Table 7.—People's Democratic Republic of Yemen: Foreign trade of crude petroleum and petroleum refinery products

(Thousand 42-gallon barrels)

Commodity	1974	1975	1976
EXPORTS AND REEXPORTS			
Petroleum refinery products:			
Gasoline	3,720	1,320	555
Jet fuel	1,889	1,100	1,027
Kerosine	1,071	733	631
Distillate fuel oil	3,788	1,270	1,936
Residual fuel oil	6,890	3,522	4,862
Other	30	429	168
Total	17,388	3,374	9,179
BUNKER LOADINGS			
Petroleum refinery products:			
Distillate fuel oil	404	NA	e [1]80
Residual fuel oil	1,104	NA	NA
Total	1,508	NA	NA
IMPORTS			
Crude	19,930	12,150	13,965
Refinery products:			
Gasoline	617	520	357
Jet fuel and kerosine	303	240	77
Distillate fuel oil	598	498	769
Residual fuel oil	34	--	220
Lubricants	--	3	16
Other	--	210	225
Total	1,552	1,471	1,664

eEstimate. NA Not available.
[1]Includes gasoline, jet fuel, and lubricants in addition to distillate fuel oil.

YEMEN ARAB REPUBLIC[22]

The mineral industry of the Yemen Arab Republic, involving the production of rock salt and cement, was an insignificant contributor to the country's expanding economy. The nation's financial stability was owing to approximately $1.0 billion in wages remitted by some 800,000 Yemeni emigrant workers, chiefly in Saudi Arabia. With this income and estimated exports of $19 million against imports of $730 million, the $711 million balance-of-trade deficit became a balance-of-payments surplus of nearly $300 million in 1977.

The Yemen Salt Mining Corp. resumed mining and export of rock salt from its mine on the coastal plain adjacent to the port of As Salif. A Canadian company examined the 68-hectare As Salif salt deposit in 1972. Its 33 drillholes, to an average depth of 100 meters, delineated total reserves of 250 million tons of rock salt with an average NaCl content of 98.23%. Minable reserves of 72 million and 115 million tons were estimated to depths of 50 and 80 meters, respectively. Mining was resumed in July 1977, and the shiploading facilities were tested and commissioned in August and September, when the first shipment of rock salt was made to North Korea against an order for 100,000 tons. In October, some 25,000 tons was shipped to Bangladesh. The mining rate was 10,000 to 12,000 tons per week,

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and the shiploading capacity was 10,000 tons per day. The targeted capacity was 1 million tons per year from a 50,000-ton stockpile into ships of 50,000-deadweight-ton capacity.

The port of As Salif, protected on the west by the island of Kamaran, is reportedly one of the best natural deepwater harbors of the Red Sea. It was under consideration as the site for substantial development, including an oil refinery and a plant to manufacture chlorine, hydrochloric acid, and caustic soda from As Salif rock salt. Iraqi dredges and staff completed deepening and widening of port facilities at Al Hudaydah, but because of the narrow, 9-kilometer-long channel, there was only a slight reduction in harbor congestion at yearend.

Some 2,300 tons of gypsum was recovered from the As Salif rock salt deposit and sold to the cement factory at Bajil, 100 kilometers to the southeast. Gypsum deposits near San'a, Ta'izz, and Heirs were also probable small producers in 1977. The 50,000-ton-per-year cement plant at Bajil was operated at less than capacity, but plans for a 300,000-ton-per-year plant were outlined as part of the 1976-80 5-year plan published in November 1977.

A Kuwaiti firm started a route survey for an 8-inch diameter, three-product pipeline to be installed from the port of As Salif, up the 7,000-foot scarp to Ma'abir, south of San'a and Ta'izz, a total distance of 460 kilometers. The minimum estimated cost of the project was $300 million. Swedish, United States, Soviet, West German, Canadian, Romanian, and Chinese representatives have explored the mineral potential of the Yemen Arab Republic during the recent past. A team of Romanian geologists arrived in San'a on July 18, 1977, to examine the copper-cobalt-nickel prospects of Al Hamra and Al Shakat, some 40 kilometers southeast of Ta'izz. It subsequently reported the presence of a large deposit of marble near the road between Ta'izz and Mocha.

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[1]Prepared by David E. Morse, physical scientist.

[2]Where necessary, values have been converted from Bahraini dinars (BD) to U.S. dollars at the rate of BD1.00 = US$2.534.

[3]Prepared by Candice Stevens, economist.

[4]Where necessary, values have been converted from Jordanian dinars (JD) to U.S. dollars at the rate of JD0.320 = US$1.00.

[5]Prepared by Candice Stevens, economist.

[6]Where necessary, values have been converted from Lebanese pounds (L£) to U.S. dollars at the rate of L£2.96 = US$1.00.

[7]Prepared by Janice L. W. Jolly, physical scientist.

[8]Where necessary, values have been converted from Omani rials (RO) to U.S. dollars at the rate of RO0.345 = US$1.00.

[9]Standard Chartered Review (London). Oman Development Bank. January 1978, p. 19.

[10]Metal Bulletin Monthly Supplement (London). Oman. November 1978, p. 67.

[11]Prepared by Janice L. W. Jolly.

[12]Where necessary, values have been converted from Qatari riyals (QR) to U.S. dollars at the rate of QR3.89 = US$1.00.

[13]Middle East Economic Survey (Cyprus). UAE-Qatar. V. 21, No. 29, p. 5.

[14]Middle East Economic Survey (Cyprus). Qatar Petroleum Producing Authority (QPPA) 1977 Production and Exports. V. 21, No. 30, May 15, 1978, p. 14.

[15]U. S. Embassy, Doha, Qatar. State Department Airgram A-13, Sept. 11, 1978, p. 15.

[16]World Oil (Middle East). Qatar. Aug. 15, 1978, p. 207.

[17]Work cited in footnote 14.

[18]Prepared by Candice Stevens.

[19]Where necessary, values have been converted from Syrian pounds (£S) to U.S. dollars at the rate of £S3.77 = US$1.00.

[20]Prepared by Candice Stevens.

[21]Where necessary, values have been converted from Yemeni dinar (SYD) to U.S. dollars at the rate of SYD1 = US$2.90.

[22]Prepared by Miller W. Ellis, physical scientist.

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The Mineral Industry of Other Areas of South America

By Doris M. Hyde[1]

CONTENTS

	Page		Page
Ecuador	1225	Paraguay	1230
French Guiana	1229	Surinam	1231
Guyana	1229	Uruguay	1232

ECUADOR

Ecuador's gross domestic product (GDP) grew 8% despite a slowdown in production and sales of petroleum, the dominant economic sector. Crude petroleum exports, which amounted to about 35% of total exports in 1977, were valued at $484 million,[2] a decrease of 14% from 1976 values. Petroleum export sales were depressed because foreign buyers were somewhat uncertain that State-owned Corporación Estatal Petrólera Ecuatoriana (CEPE) held legal title to the oil until final settlement with Ecuadorian Gulf Oil Corp. In addition to the legal complication, Ecuador maintained a relatively high export price for oil until late in the year. There was also a shrinkage of traditional U.S. markets owing to the Alaskan pipeline becoming operational and an increased availability of Mexican supplies. The export market was also affected by increased domestic production in Peru and Chile, which lessened their import needs, and the pressure of greater competition from the Middle East in supplying crude oil to Caribbean refineries. About 20.4 million barrels or 40% of Ecuador's total crude exports went to the United States.

Only 27 wells were drilled in Ecuador during 1977; of these, 16 produced oil, 3 were dry holes, and 8 were suspended. About 31 wells were planned for 1978. Three new oilfields were discovered during 1977; two by CEPE in northeastern Ecuador and one by the Argentine State oil company Yacimientos Petrolíferos Fiscales (YPF), operating in Ecuador under a service contract. CEPE's two discoveries tested at 5,000 and 1,450 barrels per day, respectively. The YPF discovery tested at about 1,000 barrels per day. Ecuador altered its position regarding

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CEPE's exclusive role in undertaking all exploration work, and it was announced that early in 1978 the Government would formulate a new oil operations contract that would be more attractive to foreign investors and thus encourage exploration activity.

The Government of Ecuador, CEPE, and Gulf executed an agreement which formally transferred to CEPE Gulf's 37.5% interest in the producing and pipeline assets owned by the CEPE-Texaco Inc.-Gulf consortium. Settlement included a provisional downpayment of $82 million with the balance of the net book value of Gulf's assets to be determined by a mutually acceptable independent European audit firm.

The small refinery retained by Gulf and the British-owned Anglo-Ecuadorian Oilfields Ltd. refinery, both located at La Libertad, were restricted to using Ecuadorean crude, and output declined. The newly constructed State-owned oil refinery at Esmeraldas came onstream and operated at about 60% capacity. This new refinery uses Ecuadorean crude. When operating at its full capacity of 60,000 barrels per day, the refinery is expected to provide for all domestic needs and to create a surplus for export.

CEPE and Texaco resolved their financial and operational differences with an agreement involving Texaco's share of the profits and participation in a new investment program. Ecuador increased overall income taxes from 71.4% to 87.3%, and Texaco's production royalties were increased from 17% to 18.5%, effective January 1977. These increases, although significant, were less than anticipated. The amounts would be calculated from quarterly averages of sales prices rather than from the posted or reference price. Other terms included dropping the fixed ratio of sales between CEPE and Texaco, dropping the fixed production cost and allowing periodic reassessments of actual costs, and a recision of Decree 285 which had fixed CEPE's share of production on the basis of 210,000 barrels per day assured total production regardless of actual production. The recision was retroactive to January 1977. For its part, Texaco agreed to a $31 million exploration and development program designed to improve recovery from existing fields and to explore for and develop new fields in the El Oriente Region. Texaco, as operator, agreed to provide $11.7 million to the new program, and CEPE will contribute the remainder. It was anticipated that this program will increase the proven reserves in the eastern oilfields to about 1.5 billion barrels. Texaco planned geological and geophysical surveys and the drilling of 10 exploration and 9 development wells during 1978.

Natural gas exploration in the Gulf of Guayaquil made minimal progress because of the inability of Northwest Pipeline Corp. and Ecuador to agree on economically feasible uses for the gas.

Cia. Ecuadoriana de Siderúrgica S.A. (ECUASIDER), the autonomous Government agency planning the construction of Ecuador's first integrated steelmaking facility, decided to locate its plant at Puerto Bolívar, near Machala. The 400,000-ton-per-year output of its one direct-reduction unit is to be used to produce a wide range of cast and rolled steel products. The plant is expected to become operational in 1982 and will use natural gas from the Gulf of Guayaquil.

Table 1.—Other Areas of South America: Production of mineral commodities

Area, commodity, and unit of measure	1975	1976	1977[p]
ECUADOR[1]			
Cadmium, mine output, metal content ... kilograms	450	[e]500	476
Cement, hydraulic ... thousand metric tons	593	616	626
Clays: Kaolin ... metric tons	2,270	[e]2,500	1,427
Copper, mine output, metal content ... do	239	[e]275	[e]300
Gas, natural:			
Gross ... million cubic feet	10,559	10,983	12,289
Marketable[e] ... do	1,100	1,100	1,200
Gold, mine output, metal content ... troy ounces	8,157	11,615	7,649
Gypsum (for cement) ... metric tons	[e]500	[e]500	43,762
Iron and steel semimanufactures ... thousand metric tons	29	NA	NA
Lead concentrate ... metric tons	119	[e]110	220
Natural gas liquids:			
Natural gasoline ... thousand 42-gallon barrels	139	128	[e]128
Liquefied petroleum gas ... do	53	[e]50	[e]50
Total ... do	192	178	[e]178

See footnotes at end of table.

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Table 1.—Other Areas of South America: Production of mineral commodities —Continued

Area, commodity, and unit of measure	1975	1976	1977[p]
ECUADOR[1] —Continued			
Petroleum:			
Crude—thousand 42-gallon barrels	58,753	68,463	66,954
Refinery products:			
Gasoline—do	5,680	6,079	4,939
Kerosine—do	1,429	1,915	1,900
Jet fuel—do	446	467	375
Distillate fuel oil—do	3,162	2,886	2,064
Residual fuel oil—do	3,583	3,776	4,954
Lubricants—do	127	132	194
Other:			
Liquefied petroleum gas—do	50	40	133
Unspecified—do	15	20	
Refinery fuel and losses—do	42	140	101
Total—do	14,534	15,455	14,660
Silica—metric tons	9,918	NA	10,800
Silver, mine output, metal content—troy ounces	37,026	52,000	57,223
Stone, sand and gravel:			
Limestone (for cement)—thousand metric tons	NA	880	NA
Marble—metric tons	NA	NA	202
Quartz—do	[r]4	NA	NA
Sulfur:			
Native—do	204	[e]1,000	[e]1,000
Byproduct:			
From petroleum[e]—do	4,794	5,000	5,000
From natural gas[e]—do	3,000	3,000	3,000
Total—do	7,794	[r e]8,000	[e]8,000
Zinc, mine output, metal content—do	83	140	1,997
FRENCH GUIANA			
Gold, mine output, metal content—troy ounces	2,437	2,820	4,822
Stone, sand and gravel—metric tons	NA	NA	329,320
GUYANA[1]			
Aluminum:			
Bauxite, dry equivalent, gross weight[e]—thousand metric tons	3,250	[r]2,686	2,731
Alumina—do	311	281	271
Diamond:[2]			
Gem[e]—thousand carats	12	8	10
Industrial[e]—do	8	6	7
Total—do	20	14	17
Gold, mine output, metal content—troy ounces	18,067	15,656	11,899
PARAGUAY			
Cement, hydraulic—thousand metric tons	138	155	200
Clays:			
Kaolin[e]—metric tons	12,000	14,000	22,000
Other—thousand metric tons	[e]780	1,100	1,320
Gypsum[e]—metric tons	15,000	16,000	14,000
Lime—do	27,707	31,863	53,300
Petroleum refinery products:			
Gasoline—thousand 42-gallon barrels	435	480	648
Jet fuel—do	46	53	69
Kerosine—do	109	127	145
Distillate fuel oil—do	834	899	1,390
Residual fuel oil—do	274	287	333
Other: Liquefied petroleum gas—do	52	39	45
Refinery fuel and losses—do	71	92	358
Total—do	1,821	1,977	2,988
Pigments, mineral, natural: Ocher—metric tons	140	120	120
Sand, including glass sand[e]—thousand metric tons	841	981	1,401
Stone:			
Dimension—do	108	130	144
Crushed and broken:			
Limestone (for cement and lime)—do	265	277	415
Other—do	2,050	2,380	3,500
Talc, soapstone, pyrophyllite—metric tons	120	140	130
SURINAM			
Aluminum:			
Bauxite, gross weight[e]—thousand metric tons	4,928	[r]4,613	4,924
Alumina—do	1,148	1,040	1,172
Metal, primary[3]—do	[r]42	46	58
Cement—do	31	50	49

See footnotes at end of table.

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Table 1.—Other Areas of South America: Production of mineral commodities —Continued

Area, commodity, and unit of measure	1975	1976	1977[p]
SURINAM —Continued			
Clays:			
Common—metric tons	NA	NA	116,000
Kaolin[3]—do	--	--	2,500
Gold, mine output, metal content—troy ounces	141	39	376
Sand and gravel:			
Sand:			
Common—thousand metric tons	200	([4])	NA
Stone sand[e]—do	3	NA	NA
Gravel—metric tons	([5])	26,000	37,800
Stone, crushed and broken—thousand metric tons	NA	137	75
URUGUAY			
Aluminum, secondary—metric tons	36	31	52
Barite—do	--	--	50
Cement, hydraulic—thousand metric tons	637	676	701
Clays, not further specified—metric tons	310,947	425,704	336,009
Coke, gashouse—do	13,152	11,685	[e]11,685
Corundum—do	417	381	421
Feldspar—do	1,759	1,145	1,625
Fluorspar—do	65	50	[e]50
Gas, manufactured—million cubic feet	836	753	[e]750
Gem stones, semiprecious:			
Agate—metric tons	85	35	802
Amethyst—do	6	2	[e]2
Iron and steel metal:			
Pig iron and cast iron—do	--	--	700
Steel, crude—do	200	263	270
Semimanufactures—do	42,089	34,841	47,265
Lime—thousand metric tons	46	70	70
Petroleum refinery products:			
Gasoline—thousand 42-gallon barrels	2,243	2,051	1,940
Kerosine—do	1,420	1,326	1,199
Jet fuel—do	196	263	269
Distillate fuel oil—do	3,104	3,365	3,355
Residual fuel oil—do	5,478	5,062	5,170
Lubricants—do	2	1	37
Other:			
Liquefied petroleum gas—do	298	384	684
Unspecified—do	210	58	
Refinery fuel and losses—do	260	229	228
Total—do	13,211	12,739	12,882
Sand and gravel:			
Sand:			
Common—thousand metric tons	1,691	1,649	1,885
Glass—metric tons	--	--	2,210
Gravel—thousand metric tons	NA	864	[e]865
Stone:			
Dimension—do	40	95	13
Crushed and broken:			
Alum schist—metric tons	1,546	1,441	2,483
Dolomite—thousand metric tons	42	34	95
Limestone—do	1,163	859	1,192
Marble—do	4	4	4
Marl—metric tons	--	8,769	900
Quartz—do	1,551	7,024	200
Other, including ballast—thousand metric tons	1,508	1,115	1,758
Sulfur, elemental, byproducts[e]—metric tons	[r]2,190	[r]2,200	2,200
Talc, soapstone, pyrophyllite—do	1,268	1,268	1,659

[e]Estimate. [p]Preliminary. [r]Revised. NA Not available.

[1]In addition to the commodities listed, a variety of crude construction materials (common clays, sand and gravel, and stone) undoubtedly are also produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2]Gem and industrial diamond production are estimated based upon a reported total.

[3]Company reported exports.

[4]Reported volumetrically as 59,183 cubic meters.

[5]Reported volumetrically as 18,000 cubic meters (revised).

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FRENCH GUIANA

There were no significant developments in the mineral industry of French Guiana during 1977. The Government maintained its policy of actively encouraging foreign participation in mineral exploitation. Minor quantities of gold, sand and gravel, and crushed stone were produced for local consumption. Esso Exploration Guyane S.A.R.L., in partnership with Eurafrep S.A., Soc. Shell de Recherches et d'Exploration de Guyane, and Soc. Nationale Elf Aquitaine, continued the offshore seismic studies begun during 1976 in the concession that adjoins their offshore holdings in Surinam. No drilling took place during 1977.

GUYANA

Despite austere import restrictions, Guyana ended the year with a total trade deficit of $55 million[3] which, although economically damaging, represented an improvement over the $84.5 million deficit accrued during 1976. Reduced world demand for calcined bauxite caused a 2% drop in shipments to 693,000 tons in 1977. Dried metallurgical-grade bauxite exports increased 6%, but alumina shipments were down. Guyana supplied about 97% of U.S. imports of calcined bauxite, which amounted to one-third of Guyana's total calcined bauxite exports.

The Government concluded a major reorganization of the bauxite industry whereby the two State-owned companies, Guyana Bauxite Co. Ltd. (GUYBAU) and Berbice Mining Co. (BERMINE), were merged into a joint company, Guyana Bauxite Mining Enterprise Ltd. (GUYMINE). GUYMINE will operate under a newly formed holding company, Bauxite Industry Development Co. Ltd. (BIDCO). Any new entities established to mine or process bauxite would also be under the supervision of BIDCO, which has the responsibility for expanding the bauxite industry and for providing common services to existing State mining operations.

Guyana began a feasibility study for a 150,000-ton-per-year aluminum smelter, expandable to 200,000 tons in the future. Ultimate development of the smelter is tied to the construction of the ambitious 750- to 1,000-megawatt hydroelectric scheme planned for the Upper Mazaruni River. Guyana continued to pursue the problem of obtaining adequate financing and technological assistance for these projects. In anticipation of the hydroelectric project development, the Government commenced construction of a 180-mile (293-kilometer) access road to the dam site, but late in 1977 budgetary problems forced suspension of work.

Progress continued on construction of an alumina calcining kiln near GUYMINE's alumina plant in Linden. The kiln, a Lurgi Fluid Bed Calciner, has a 290,000-ton-per-year capacity and is expected to result in a savings of 40% on the fuel cost of the conventional rotary kiln. Maintenance costs and alumina losses should be lower. Work is to be completed in 1978.

A feasibility study was planned for the development of a small, 3-million-ton, high-quality kaolin deposit at Ituni. The kaolin underlies mined-out bauxite deposits. Analyses of the material compare favorably with Georgia kaolin. The study would include the possible construction of a 140,000-ton-per-year plant to produce paper-coating and paper-filler grades for export. About half of the plant's capacity would be for refractory-grade kaolin for local consumption.

Table 2.—Guyana: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975[r]	1976	Principal destinations, 1976
Aluminum:			
Alumina:			
Hydrated	NA	15,553	All to United States.
Unhydrated	250,889	251,861	Norway 115,116; United States 47,614; United Kingdom 36,390.
Bauxite:			
Calcined	742,434	704,595	United States 209,989; United Kingdom 114,124; West Germany 78,075.
Other[1] thousand tons	934	896	Canada 447; United States 404.

See footnotes at end of table.

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Table 2.—Guyana: Exports and reexports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1975[r]	1976	Principal destinations, 1976
Diamond, gem ____ carats	11,844	9,625	Belgium-Luxembourg 5,224; United Kingdom 2,276.
Gold metal, unworked or partly worked, all forms troy ounces	511	69	All to Belgium-Luxembourg.
Iron and steel semimanufactures	2,319	1,055	Trinidad and Tobago 662.

[r]Revised. NA Not available.
[1]Excludes unreported amounts of dried refractory bauxite.

Table 3.—Guyana: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975[r]	1976	Principal sources, 1976
METALS			
Aluminum metal including alloys, all forms	NA	438	United Kingdom 183; West Germany 123; United States 89.
Iron and steel metal including alloys, all forms	7,971	557	United Kingdom 180; United States 140; Jamaica 65.
NONMETALS			
Barite and witherite	836	NA	
Clay products (including all refractory brick) value, thousands	$2,130	$504	United Kingdom $395; United States $109.
Fertilizer materials, manufactured:			
Nitrogenous	29,164	24,577	Trinidad and Tobago 23,956.
Phosphatic	4,533	6,195	United States 5,784.
Potassic	3,486	3,482	France 3,114.
Salt	3,349	5,337	Canada 2,969; United Kingdom 1,497.
Sodium compounds, n.e.s.: Caustic soda	33,826	106,806	United States 105,987.
Stone: Limestone pulverized	8,467	80,658	Puerto Rico 49,895; Bahamas 27,310.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	3,192	2,330	Trinidad and Tobago 1,287; Netherlands Antilles 1,042.
Petroleum refinery products:			
Gasoline ____ thousand 42-gallon barrels	404	364	All from Trinidad and Tobago.
Kerosine and jet fuel ____ do.	198	165	Do.
Distillate fuel oil ____ do.	1,190	1,150	Trinidad and Tobago 1,140.
Residual fuel oil ____ do.	2,132	2,518	All from Trinidad and Tobago.
Lubricants ____ do.	41	74	United States 31; Trinidad and Tobago 18; Jamaica 17.
Other:			
Liquefied petroleum gas ____ do.	67	63	Trinidad and Tobago 29; Netherlands Antilles 26.
Mineral jelly and wax ____ do.	NA	2	United Kingdom 1.
Total ____ do.	4,032	4,334	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	NA	149	Mainly from United Kingdom.

[r]Revised. NA Not available.

PARAGUAY

Paraguay's gross national product (GNP) rose about 12% in real terms during 1977; the major impetus came from the giant Itaipu Dam project being built in partnership with Brazil. Cement for the booming construction industry remained the major mineral product.

Reynolds Aluminum Co. of Canada Ltd. and the Government of Paraguay were unable to agree on power costs and other details for establishing an aluminum refinery, and negotiations were terminated. Anschutz Corp. continued its mineral exploration activities in eastern Paraguay and

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planned to commence a drilling program in early 1978. Mineral possibilities are lead, zinc, copper, and nickel. Korea Electric Co. Ltd. of Seoul joined in partnership with Anschutz to prospect for radioactive minerals. Previous surveys reported that monazite containing 7.75% thorium and 870 parts per million of uranium was present in the tillite at Cerro Itappo near the Brazilian border. This occurrence was reportedly in pebbles believed to have been derived from the Caapucú area. The deposit was never developed.

Increased drilling activity in the Chaco region failed to result in any oil discovery. Chaco Exploration Co. remained optimistic regarding western Paraguay's hydrocarbon potential. It drilled two test wells in the northwestern Chaco region and planned further tests to evaluate its 4.1-million-acre area of interest. Texaco and Marathon Oil Co. each took a 25% interest in Esso Co.'s prospecting concession in the central Chaco Region. In northern Chaco, Texaco and Marathon began their wildcat program. One well had been drilled and one was in progress at yearend. The Esso-Aminoil Inc. partnership abandoned its deepest test to date in the southwestern Chaco Region. Trend Resources Ltd. made seismic studies on the eastern side of the Paraguay River. Trend holds a concession of about 7.5 million hectares and was reportedly seeking a partner. An area in northern Chaco was taken under an exploration contract by Piper Oil Co., a consortium formed by two U.S. companies, Samuel Gary and Webb Resources, Inc. Piper did not plan to drill in the coming year.

Table 4.—Paraguay: Imports of mineral commodities

(Metric tons unless otherwise specifed)

Commodity[1]		1975	1976
Aluminum metal, all forms		184	381
Asphalt, natural		2,912	5,366
Copper metal, all forms		9	3
Iron and steel metal, all forms		21,261	21,086
Lead metal, all forms		22	19
Nonmetals, n.e.s		11,719	14,758
Petroleum:			
Crude	thousand 42-gallon barrels	r1,906	1,977
Refinery products:			
Gasoline	do	--	180
Distillate fuel oil	do	173	281
Residual fuel oil	do	64	130
Lubricants	do	r10	6
Other	do	110	9
Total	do	357	606
Salt		22,965	24,687
Tin metal, all forms		9	18

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[1]In addition to the commodities listed individually, Paraguay reports the importation of "precious stones and metals" totaling 2 metric tons in 1975 and 2 metric tons in 1976.

SURINAM

The bauxite industry remained the mainstay of Surinam's economy and accounted for 85% of total exports during 1977. Exports of bauxite, alumina, and aluminum increased over those of 1976, but with the exception of aluminum did not reach their 1973 levels. Higher aluminum prices softened the economic impact on Surinam's balance of trade.

Surinam continued its determined effort to develop its western bauxite deposits in the Bakhuis Mountains near the Corantijn River. N.V. Grassalco, a State-owned company, actively sought foreign participation for this ambitious mining-refining project. Bauxite reserves in the area were estimated to be 50 million tons grading at least 42% alumina. Another group of deposits farther south has also been investigated. Financial arrangements and any outside participation in the project were not finalized. Construction continued on the 75-kilometer railroad that will connect the port of Apoera on the Corantijn River to the Bakhuys Mountains

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mining area. Feasibility studies were completed for the construction of a 575,000-ton-per-year refinery at Apoera to process most of the Bakhuis Mountains bauxite.

Financing for the Kabalebo hydroelectric project was provisionally secured during 1977. The project construction is crucial to western Surinam's development plans. The Kabalebo project would initially consist of a 500-megawatt power station at Devis Falls on the Kabalebo River, to be followed by a 300-megawatt station at the Kabalebo airport and by a third, as yet unidentified, station.

Although hydrocarbons have never been found in Surinam, two companies planned to initiate exploration activity. A Venezuelan company, Las Mercedes de Petrolera, acquired an exploration contract covering 500 square miles off the northeastern coast of Surinam's Saramacca District. Esso Petroleum Surinam N.V., working with its partners, Eurofrep, Shell Surinam N.V., and Elf Petroleum Surinam N.V., planned to begin exploratory drilling about 70 miles off the coast of Surinam near its sea boundary with French Guiana.

Table 5.—Surinam: Exports of aluminum, by type[1]

(Metric tons)

Type	1975	1976	Principal destination, 1976
Bauxite	2,170,031	1,913,956	United States 1,601,454; Denmark 90,061; West Germany 39,229; Canada 13,703.
Alumina	1,056,368	811,348	Norway 287,255; United States 190,921; Netherlands 186,253; United Kingdom 95,656.
Aluminum metal including alloys, all forms	25,039	44,026	United States 20,940; West Germany 10,709; Italy 4,891; United Kingdom 4,807.

[1]Compiled from official import statistics of trading partner countries.

URUGUAY

Uruguay continued its efforts to overcome the effects of petroleum import costs. Expectations diminished when Chevron Oil Co., after drilling two dry holes in 1976, reassessed prospects and contractual obligations and decided to relinquish its 10,000 square miles of offshore holdings. The contract required Chevron to drill four wells with the option of paying a $1.5 million penalty per undrilled hole. The Administración Nacional de Combustibles, Alcohol y Portland (ANCAP), the State-owned entity responsible for hydrocarbon activity, continued its oil exploration program in the Santa Lucía River basin near Montevideo. ANCAP contracted for 870 line miles of offshore seismic survey in preparation for the startup of exploration drilling.

The French Bureau de Recherches Géologiques et Minières (BRGM) completed a preliminary survey of mineral prospects in Uruguay. The survey indicated the presence of gold, manganese, copper, lead, and zinc in the southwest border region and in the Department of Rivera. A French delegation conferred with the Government and local mining interests regarding possible development of these resources.

A feasibility study was undertaken to determine the potential of a 30-million-ton iron ore deposit at Arroyo Valentín in the northeastern part of the Department of Florida. The iron ore deposit would be used to supply a projected $140 million iron and steel complex which could make Uruguay self-sufficient in basic steel products and also supply iron ore pellets for export purposes. Previously worked gold properties in northern Uruguay have now been acquired by Pavonia S.A. A 1976-77 sampling and mapping survey was completed, and drilling was planned.

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[1]Physical scientist, Branch of Foreign Data.

[2]Where necessary, values have been converted from Ecuadorean sucres (S/) to U.S. dollars at the rate of S/25=US$1.00.

[3]Where necessary, values have been converted from Guyanese dollars (G$) to U.S. dollars at the rate of G$2.55=US$1.00.

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The Mineral Industry of Other South Pacific Islands

By Walter C. Woodmansee[1]

CONTENTS

	Page		Page
British Solomon Islands	1233	New Caledonia	1239
Christmas Island	1234	New Hebrides	1240
Fiji	1235	Papua New Guinea	1241
Nauru and Ocean Island	1238	Tonga	1243

BRITISH SOLOMON ISLANDS

The only reported mineral production in 1977 was small output of alluvial gold, valued at an estimated $54,320.[2] In addition, marine shells are gathered for use in lime manufacture, although output was not reported.

Proposed development of a bauxite mine and smelter, involving Rennell and Vaghena Islands, was deferred in June. Conzinc Riotinto of Australia Ltd. (CRA), in partnership with Mitsui Mining & Smelting Co. Ltd., and the Solomon Government, withdrew from the project, and Mitsui, which conducted a feasibility study and metallurgical testing of the bauxite, decided to defer further work because of slack demand for aluminum in Japan and difficulties in arranging financing. The Mitsui feasibility studies reportedly indicated that the project could be viable despite technical difficulties and relatively high initial investment costs. The project was to produce 1.5 million tons of bauxite and 600,000 tons of alumina per year from reserves totaling 60 million tons at 45% to 50% Al_2O_3.

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Table 1.—Other Pacific Islands: Production of mineral commodities

Area and commodity		1975	1976	1977[p]
BRITISH SOLOMON ISLANDS[1]				
Gold	troy ounces	804	600	372
CHRISTMAS ISLAND[1]				
Phosphate rock	thousand metric tons	1,391	1,033	1,186
FIJI				
Cement, hydraulic	metric tons	74,000	69,000	77,488
Gold, mine output, metal content	troy ounces	68,744	65,757	49,067
Lime[2]	metric tons	2,826	2,666	1,997
Silver, mine output, metal content	troy ounces	26,462	19,773	14,695
Stone, sand and gravel:				
Coral sand for cement manufacture	metric tons	55,608	78,316	107,861
River sand for cement manufacture	do.	45,887	52,783	41,494
River sand and gravel	cubic meters	551,550	851,762	562,898
Other quarried stone	do.	262,497	181,683	107,698
Tellurium metal	kilograms	--	1,109	NA
NAURU AND OCEAN ISLAND[1]				
Phosphate rock, marketable:				
Nauru (exports)	thousand metric tons	1,534	755	1,146
Ocean Island	do.	516	417	446
NEW CALEDONIA				
Cement	metric tons	58,032	54,180	50,605
Chromium, chromite, gross weight	do.	2,051	9,537	8,310
Cobalt contained in metallurgical products of nickel:				
In ferronickel[e]	do.	1,580	1,150	850
In matte[e]	do.	130	170	160
Total[e]	do.	1,710	1,320	1,010
Giobertite	do.	NA	653	--
Nickel:				
Ore:				
Gross weight	thousand metric tons	6,693	5,921	5,839
Metal content[3]	metric tons	115,761	109,912	105,106
Metallurgical products, nickel content:				
In ferronickel	do.	52,802	38,142	28,283
In matte	do.	18,266	23,759	23,038
Total	do.	71,068	61,901	51,321
Stone, sand and gravel:				
Stone:				
Crude (unspecified)	cubic meters	58,000	38,000	NA
Crushed	do.	170,000	108,000	NA
Sand	do.	82,000	63,000	NA
Silica (for metallurgical use)	do.	21,358	28,862	NA
NEW HEBRIDES[1]				
Manganese:				
Ore	metric tons	290,000	287,000	NA
Concentrate, gross weight	do.	46,520	[e]46,000	NA
PAPUA NEW GUINEA[1]				
Copper, mine output, metal content	do.	172,477	175,806	182,029
Gold, mine output, metal content	troy ounces	611,356	1,228,576	739,730
Silver, mine output, metal content	do.	1,384,325	1,840,628	1,522,750

[e]Estimate. [p]Preliminary. NA Not available.

[1]This area undoubtedly provides crude construction materials (common clays, sand and gravel, and/or stone) in addition to the listed commodities, but output is unreported and information is inadequate to make reliable estimates of output levels.

[2]Produced from an unreported amount of domestically quarried limestone.

[3]Nickel-cobalt content of metallurgical plant products, plus nickel-cobalt in exported ores.

CHRISTMAS ISLAND

Production and exports of phosphate rock, the island's only significant mineral product, is shown in tables 1 and 2, respectively.

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Table 2.—Christmas Island: Shipments of phosphate rock by destination

(Thousand metric tons)

Destination	1975	1976	1977
Australia	796	480	541
Indonesia	13	7	13
Malaysia		133	--
Singapore	132	--	133
New Zealand	402	417	575
Total	1,343	1,037	1,262

Source: International Superphosphate and Compound Manufacturers' Association Ltd.

FIJI

The Dominion of Fiji's principal mineral products were gold, construction materials, and cement. Reported total value of mineral output in 1977 was $18.3 million.[3]

Output of cement, and coral sand was substantially higher, but gold and silver production from Fiji's one operating gold mine was down from that of 1976.

A number of United States, British, Australian, and Japanese mining interests conducted exploration projects during the year. Significant mineral discoveries were announced, but there were no new mines under development. At yearend, 33 prospecting licenses covering 544,984 acres and 3 mining leases covering 2,988 acres were in effect.[4]

Table 3.—Fiji: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum metal including alloys, all forms	6	1
Copper metal including alloys, all forms	84	81
Gold bullion, troy ounces	68,756	65,757
Iron and steel:		
Scrap	1,994	847
Steel, primary forms	33	4
Semimanufactures	168	161
Lead metal including alloys, all forms	55	52
Silver bullion, troy ounces	44,471	23,573
Titanium oxide	(1)	1
NONMETALS		
Abrasives, natural, n.e.s, value	$226	--
Cement	11,908	8,189
Clays and clay products (including all refractory brick):		
Refractory (including nonclay brick), value	$632	$449
Nonrefractory, do	$5,167	$9,857
Diatomite and other infusorial earths, do	--	$111
Fertilizer materials, manufactured:		
Nitrogenous	--	15
Other, including mixed, value	--	$82
Lime, do	$24	--
Salt	(1)	11
Sodium compounds, caustic soda	(1)	(1)
Stone, sand and gravel, value	$486	$4,272
Sulfur, sulfuric acid, do	$290	$29
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	(1)	--
Hydrogen, nitrogen, rare gases, value	$3,944	$1,745
Petroleum refinery products:		
Gasoline (including natural):		
Motor, thousand 42-gallon barrels	124	115
Aviation, do	25	11
Kerosine and jet fuel, do	612	781
Distillate fuel oil, do	282	286

See footnotes at end of table.

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Table 3.—Fiji: Exports and reexports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum refinery products —Continued			
Residual fuel oil	thousand 42-gallon barrels	142	71
Lubricants	do	2	2
Other:			
White spirit	do	5	6
Liquefied petroleum gas	do	1	1
Total	do	1,193	1,273
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	value	$58	$82

[1]Less than 1/2 unit.

Table 4.—Fiji: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS			
Aluminum metal including alloys, all forms	value	$436	$597
Copper metal including alloys:			
Matte		--	1
Scrap		11	[1]
Unwrought and semimanufactures		62	53
Gold metal, unworked or partly worked	troy ounces	1,072	1,984
Iron and steel metal:			
Scrap		[2]	27
Pig iron including cast iron		64	132
Ferroalloys and similar materials	value	$3,690	$16,814
Steel, primary forms		2,891	9,570
Semimanufactures:			
Bars, rods, angles, shapes, sections		4,599	3,290
Universals, plates, sheets		5,835	10,812
Hoop and strip		118	258
Rails and accessories	value, thousands	$1,062	$241
Wire		1,742	2,693
Tubes, pipes, fittings		[3]737	[4]811
Castings and forgings, rough	value, thousands	$13	$36
Lead metal including alloys, all forms	do	$129	$102
Nickel metal including alloys, all forms	do	$2,532	$3,651
Platinum-group metals including alloys	value	$51,871	$105,734
Titanium oxides		83	187
Zinc metal including alloys:			
Scrap	value	$299	$10,814
Blue powder	do	$2,664	$20,546
Unwrought		25	70
Semimanufactures	value	$4,304	$14,751
Other:			
Oxides, hydroxides and peroxides of metals, n.e.s	do	$45,161	$41,720
Ores and concentrates, ash and residue	do	$599	$234,494
Metals including alloys, all forms, pyrophoric alloys	do	$3,206	$587
NONMETALS			
Abrasives, natural	do	$115,183	$120,135
Asbestos	do	$138	$59
Barite and witherite		2	13
Cement		305	3,514
Chalk, earth colors, etc		73	110
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s		32	29
Products:			
Refractory (including nonclay brick)	value	$217,470	$89,504
Nonrefractory	do	$385,018	$283,326
Diamond, industrial	do	$293	$544
Diatomite and other infusorial earths		138	56
Fertilizer materials:			
Crude:			
Nitrogenous		--	25
Potassic		421	301
Manufactured:			
Nitrogenous		28,007	23,304
Phosphatic		6,860	3,868
Potassic		2,691	1,621
Other, including mixed		411	794
Graphite, natural	value	$910	$953

See footnotes at end of table.

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Table 4.—Fiji: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS —Continued			
Gypsum and plasters		2,491	281
Precious and semiprecious stone, except diamond	value, thousands	$275	$4,100
Salt		2,171	2,547
Sodium compounds, caustic soda		326	786
Stone, sand and gravel:			
Dimension stone and gravel	value	$56,200	$16,905
Sand, excluding metal bearing		183	66
Sulfur, including sulfuric acid	value	$53,164	$69,129
Other nonmetals, n.e.s.:			
Crude	do	$7,295	$3,573
Slag, dross and similar waste, not metal bearing	do	$2,969	$428
Unspecified	do	$14,104	$11,682
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		37	655
Coal, coke and peat		16,806	9,390
Hydrogen, nitrogen, rare gases	value	$18,692	$37,398
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	3	(2)
Petroleum refinery products:			
Gasoline, including natural:			
Motor	do	432	343
Aviation	do	12	27
Kerosine	do	141	126
Jet fuel	do	742	633
Distillate	do	1,042	881
Residual	do	215	139
Lubricants	do	39	27
Other:			
Liquefied petroleum gas	do	17	20
Naphtha	do	19	19
Unspecified	do	15	2
Total	do	2,674	2,217
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	value	$16,474	$21,960

[1]Quantity not reported; value was $13.
[2]Less than 1/2 unit.
[3]Partial figure; value of reported quantity is $483,779; an additional unreported quantity valued at $346,055 was also imported.
[4]Partial figure; value of reported quantity is $435,155; an additional unreported quantity valued at $354,630 was also imported.

The Seventh Development Plan, initiated in 1976, provided for an expanded mineral resources program conducted by the Ministry of Lands and Mineral Resources, Mineral Resources Division. This program included regional geological mapping, economic and environmental studies in potential mining areas, ground-water assessment, offshore geological and geophysical studies, work on geothermal potential in hot springs areas, administration of the Mining, Quarries and Explosives Acts, and liaison with private mining companies.

In the private sector, a number of exploration projects on Viti Levu and Vanua Levu, the largest islands, reached the drilling stage. Amax Exploration (Australia) Inc. was conducting a 15,000-meter drilling project in the upper Waidina River area, 32 kilometers west-northwest of Suva.

Amoco Minerals Fiji Ltd. was drilling several prospects in southwestern Viti Levu. United States Steel International Inc., with associates, was active in the Mouta and Natewa areas. Aquitaine Fiji Ltd. planned further work in the Sambeto Range and was drilling a prospect in the Tawaravu Creek area.

COMMODITY REVIEW

Metals.—*Copper.*—Road building, drill site preparation, environmental impact studies, and exploration drilling were underway at the large, low-grade porphyry copper deposit at Namosi on Viti Levu, where preliminary estimates indicated an ore body of 400 million tons at 0.4% to 0.5% copper. In September, CRA, through its subsidiary Copper Resources (Fiji) Ltd., joined the operating consortium, which also included RST (Fiji) Inc. (exploration manager and a subsidiary of Amax Exploration

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(Australia) Inc.), Anglo Pacific (Namosi) Ltd. (a subsidiary of Australian Anglo American Ltd.), and Preussag (Fiji) Ltd. of the West German Preussag Group.

Gold.—Mining operations of Emperor Gold Mining Co. Ltd. at Vatukoula were at a rate similar to those of 1976, although gold recovery was lower because of reduced millhead grades. Ore production was as follows, in metric tons:

Ore source	Quantity
Stopes	229,190
Development	19,605
Open pit	28,032
Total	276,827

Millfeed totaled 277,864 tons at an average millhead grade of 0.23 troy ounce per ton. Production delays were caused by shortages of chemicals and spare parts and labor problems. A new flotation circuit, using soda ash, went into operation.

Early in the year, Emperor Gold Mines considered closing the Vatukoula mine owing to continued financial losses during a period of low gold prices, inflated costs, and labor unrest. In order to keep the mine, which employed 1,500 Fijians, in operation, the Government granted financial assistance in the form of tax relief and interest-free loans. In October, Emperor reported a loss of $1.5 million during the fiscal year ending June 30, 1977. In November, the Government acted to advance all losses for 28 months from March 1, 1977, as loan funds to a maximum of $2.28 million, which would be repaid out of future pre-tax profits. At yearend, losses were still incurred because of slipping millhead grades, although the gold price was rising. The company considered that a cutoff grade of 0.33 troy ounce per ton would be necessary to maintain a viable operation. The Government was undecided about further financial support and was considering purchase of the mine.

Nonmetals.—Emperor operated the limestone quarry at Tau for the production of burnt lime but did not report limestone production. In 1977, 17 sand and gravel licenses were granted, an increase over that of 1976, although licensing was disrupted by the need for new procedures to determine compensation for damages to fishing grounds.

Fiji Industries Ltd. dredged 107,861 tons of coral sand from Suva harbor and 41,494 tons of common sand and gravel from the Rewa River and its tributaries.

The Government's Mineral Resources Division completed a drilling project on a phosphatic clay deposit on the island of Tuvutha and reported resources of 1.5 million tons containing 10% P_2O_5.

Mineral Fuels.—*Petroleum.*—Offshore petroleum exploration licenses were granted to Dakota Exploration (Fiji) Ltd. for 7,800 square kilometers and to Pacific Energy for Minerals Ltd. for 7,460 square kilometers.

Principal imports of petroleum refinery products in 1977 were as follows (in thousand barrels): Motor gasoline, 459; aviation turbine fuel and kerosine, 848; distillate fuel oil, 1,350; and residual fuel oil, 173. The principal sources of these petroleum products were Australia and Singapore.

NAURU AND OCEAN ISLAND

Shipments of high-grade phosphate rock from these two islands, which are about 300 kilometers apart near the Equator and have similar phosphate deposits, were higher than those of 1976. Shipments by Nauru Phosphate Corp. from the Republic of Nauru, the larger producer by far, rebounded from the slack 1976 year, and increased by 52%. Deposits on Ocean Island, which was administered as part of the Gilbert Islands, were expected to be depleted in or near 1980.

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Table 5.—Nauru and Ocean Island: Shipments of phosphate rock by destination

(Thousand metric tons)

Destinations	Nauru		Ocean Island	
	1976	1977	1976	1977
Australia	305	660	278	277
Japan	7	85	--	--
Korea, Republic of	48	42	--	--
New Zealand	369	359	142	141
Taiwan	26	--	--	--
Total	755	1,146	420	418

Source: International Superphosphate and Compound Manufacturers' Association, Ltd.

NEW CALEDONIA

Mineral production was limited to the mining and smelting of nickel to matte and ferronickel, byproduct cobalt from the nickel operations, chromite, and certain pit and quarry construction materials. Exports of nickel ore, matte, and ferronickel provided important revenues to the New Caledonian economy.

Mine output of nickel ores by Société Métallurgique Le Nickel (SLN) was down slightly from that of 1976 and substantially below the peak output attained in 1974. Exports in 1977 were valued as follows, in thousand dollars: Ore (to Japan), $71,857; matte, $91,877; and ferronickel, $130,809.[5] The average export ore grade was 2.39% nickel. The Doniambo smelter at Noumea operated at about 70% of capacity; the idle capacity was mainly for ferronickel. Despite this idle capacity, SLN continued to plan a $200 million smelter capacity expansion from the current 85,000 tons of nickel per year in matte and ferronickel and to 100,000 tons per year, mainly by improvements in ore preparation and calcining. This project was scheduled for completion in 1981.

Table 6.—New Caledonia: Exports of selected mineral commodities

(Metric tons unless otherwise specified)

Commodity[1]	1974	1975	1976
Chromite, gross weight (50.045% Cr_2O_3)	3,566	1,001	NA
Nickel:			
Ore, gross weight[2] thousand tons	3,347	2,446	2,693
Smelter products, nickel content:			
Ferronickel:			
Electric grade (FN4 grade, 25.1% nickel-cobalt)	12,481	11,546	10,305
Sulfur extracted grade (FN3 grade, 24.5% nickel-cobalt)	8,620	10,613	6,151
Refined grade (FN2 grade, 26.3% nickel-cobalt)	670	382	3,622
Over refined grade (FN1 grade, 27.5% nickel-cobalt)	9,896	9,014	
Other:			
FN5 grade, nickel-cobalt content not specified	442	--	--
FN6 grade, nickel-cobalt content not specified	15,014	11,104	10,136
Nickel matte (79% nickel-cobalt)	20,073	19,417	21,276

NA Not available.

[1]Cobalt content of smelter products not available.

[2]Nickel-cobalt content is reported as follows in tons: 1974-60,645; 1975-44,693; 1976-47,984.

Source: Service de la Statistique. Annuaire Statistique de la Nouvelle Caledonie, 1977. Nouméa, 1977, pp. 115, 119.

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Table 7.—New Caledonia: Imports of selected mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976
Cement	98,712	53,116	43,495
Coal	108,665	--	--
Coke	18,858	11	--
Gypsum	13,535	--	--
Iron and steel:			
Bars	6,014	5,915	4,872
Angles, shapes, sections	3,578	2,251	2,261
Plates and sheets	6,021	4,250	4,842
Petroleum refinery products:			
Gasoline, thousand 42-gallon barrels	346	415	460
Kerosine, do	37	32	37
Distillate fuel oil, do	1,068	403	383
Residual fuel oil, do	4,183	4,305	3,513

Source: Service de la Statistique, Annuaire Statistique de la Nouvelle Caledonie, 1977. Nouméa, 1977, pp. 175-176.

Nickel ore for domestic smelting and for the export market was produced at four major centers—three (Thio, Kouaoua, and Poro) near the east coast and one (Nepoui) near the west coast. Expansion continued at the Népoui mine, the largest producer, to 2 million tons of ore per year and at Kouaoua to 1.2 million tons per year.

Amax Nickel Inc. acquired a 49% interest, following negotiations with Bureau de Recherches Géologiques et Minières (BRGM), the French Government-controlled agency, which held 51%, in a $600 million, fully integrated nickel project in the Tiébaghi, Poum, and Isle Art regions at the northern end of New Caledonia. Initially, smelter capacity would be 40,000 tons of nickel per year. Reserves of 55 million dry tons of ore at 2.5% nickel in garnierite, including 10 million tons at 3% nickel, would be mined at a rate of 1 million tons per year. Amax was interested in shipping this smelter nickel to its Port Nickel refinery in Louisiana.

In an agreement concluded with BRGM, International Nickel Co. of Canada Ltd. (INCO) will conduct a 5-year feasibility study on laterite development for nickel in the southern part of the island. INCO would be required to take a French partner before the development stage.

Energy requirements were considered a potential problem since New Caledonia had no domestic energy resources. Imported fuel oil was the principal industrial source of energy. The Plaine des Lacs region was considered to have some potential for hydroelectric development.

Production of chromite, containing 39.5% Cr_2O_3, in the Tiébaghi area was 13% below that of 1976. Chromite exports, mainly to Japan, were valued at $276,000. Société de la Tiébaghi, a subsidiary of INCO and the operating company, drove an adit to the mineralized zone and was conducting a drilling program. BRGM studied chromite prospects in peridotite rocks along the southern coast.

NEW HEBRIDES

Production of manganese concentrate, New Hebrides' only reported mineral product, dropped off markedly from 1976 output. The mine, located at Forari, 55 kilometers northeast of Port-Vila on Efate Island, was operated by Le Manganèse de Vate (LMV), owned by Southland Mining Ltd. of Australia (87.5%) and public shareholders (12.5%). This company had 110 employees, largely native New Hebrideans, and shipped a 40% to 42% manganese concentrate of metallurgical grade under contract to Japan. The market value was US$35 per ton for a 40% manganese product. The ore was mined by a bulldozer, a 2-1/2-cubic-yard dragline, and a 7-cubic-yard front-end loader, and was hauled by truck to a concentrator, where the ore was crushed and washed to separate coral and clay.

Although manganese concentrate is the only mineral for which production is reported, other mineral resources were worked or were under investigation.[6] Samples of large deposits of pozzolan, a consolidated volcanic ash, on Efate and other islands were shipped from Forari to Australia and Fiji to test for use in cement. Coral

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reef limestone and sand and gravel were used in roads, other public works, and buildings. Known sulfur resources occur on Vanua Lava. Metallurgical limestone, copper, and zinc were studied on Santo Island; and beach sand deposits containing magnetite, ilmenite, and other ore minerals were under review on Pentecost Island. There was interest in offshore exploration for petroleum and seabed metallic nodules.

According to the Service des Mines et de l'Hydrologie, eight parties held valid authorizations for mineral prospecting at yearend. These included the BRGM, Kennecott Explorations (Australia) Ltd., Southland Mining, Melanesia Exploration Ltd., CRA Exploration Pty. Ltd., and private individuals.

PAPUA NEW GUINEA

Principal mineral products in Papua New Guinea were copper, gold, and silver. Except for relatively small output at another gold mine, these metals were in copper concentrates from the Panguna open pit on Bougainville Island. They contributed significantly to Government revenues and the gross domestic product (GDP). Values of 1977 output were: Copper, $149 million; gold, $108 million; and silver, $6 million,[7] together making up nearly 17% of the GDP, estimated at $1,563 million in fiscal year 1977 (ending June 30, 1977). Copper's share of the GDP was reduced to 9.5% from 19.1% in fiscal 1976, owing to an expanding GDP and a lower copper sales value.

A number of promising porphyry copper prospects were under investigation, following agreements with the Papua New Guinea Government. Some of these copper deposits contained potentially byproduct gold, silver, and/or molybdenum. Exploration was also underway for chromite and nickel, and an international consortium was drilling for offshore and onshore oil.

The National Investment and Development Authority (NIDA), Central Planning Office, which was set up in 1973 to promote foreign investment, announced a 5-year National Expenditure Plan to define development objectives beginning in 1978. Three agreements had been negotiated—with Bougainville Copper Ltd. (BCL), the OK Tedi Development Co. Copper Project consortium, and U.S.-based oil companies for petroleum exploration.

The Mineral Resources Stabilization Fund was also established. All income from mineral resource development would enter this fund, which would provide for budget revenues.

Late in the year, the Government introduced a White Paper on mining policy, defining tax and other financial terms for mining operations, as a forerunner of legislation to be presented to the Parliament in 1978. The proposed legislation would be based on provisions of revised agreements for the Bougainville copper, OK Tedi copper, and petroleum exploration, which would not be affected by new legislation enacted in 1978. The new financial policy would involve a Government equity, royalty on sales, a withholding tax, and a profits tax on high return on investment. In turn, the Government would guarantee free convertibility of its currency for payments overseas; freedom from imposts, discriminatory taxes, and import duties; and assistance in infrastructure development.

COMMODITY REVIEW

Metals.—*Chromite.*—Amax Exploration (Australia), a subsidiary of Amax Inc., concluded an exploration agreement with the Papua New Guinea Government for chromite and other minerals in beach sands along the Morobe coast, between Salamaua and Salua. Preliminary estimates indicated reserves of 200 million tons of mineralized sands containing 1.5% chromium.

Copper.—Output of concentrate at the Panguna mine of BCL Bougainville Island was higher than that of 1976, but sales revenue was lower at $264 million, compared with $270 million in 1976; net earnings were also reduced to $37.1 million from $53.8 million in 1976. The losses in revenues and profits were attributed to a slump in the copper market price and rising costs. A total of 34.1 million tons of ore was milled at an average millhead grade of 0.61% copper. During the first half of the year, the millhead grade fell from 0.64% to 0.60% copper owing to a harder, lower grade ore-type mined.

In March, BCL announced a $50 million development program, including a $12.3

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million, 7-kilometer tunnel, a 10th ball mill, and new, larger, 170-ton electric-wheel-drive trucks for ore haulage. The tunnel was planned to drain the open pit, which flooded during the monsoonal season, and eliminate drainage pumping. The new ball mill, which went onstream in May, increased mill capacity by 10%.

Panguna ore reserves, as of August 1977, were 900 million tons at 0.48% copper.

OK Tedi is a Government organized company for managing the work program at the OK Tedi Copper Prospect, which is located at Mount Fubilan in the remote rain forest of the Star Mountains, near the Irian Jaya border, at an elevation of 2,070 meters. Interests in the company were as follows: Dampier Mining Co. Ltd. (a subsidiary of BHP Co.) 30%; Mount Fubilan Development Co. Pty. Ltd. (a subsidiary of Amoco Minerals Ltd.) 30%; Kupferexploration GmbH (Federal Republic of Germany) 20%; and the Papua New Guinea Government, 20%. Stage 2, started in late 1976, called for submittal of a $10 million feasibility study and proposed work program, including mine development, a townsite, infrastructure, and port facilities, to the Government in 1979, following which a decision would be made on proceeding with development. Stage 2 exploration drilling was near completion at yearend, and Stage 3 drilling was planned. An ore reserve target of 250 million tons at 0.85% copper was considered necessary for a viable commercial operation, which would require a capital investment of more than $700 million. In May, 270-meter and 540-meter adits were being driven on an around-the-clock, 7-day-a-week basis, to test the ore at two levels. The upper adit was designed for sampling a gold-bearing capping zone.

A number of other copper prospects were under investigation. The Frieda prospect in Western Sepik Province was the subject of a feasibility study by Frieda Exploration Pty. Ltd., operator for Overseas Mineral Resources Development Co., a Japanese group. This group managed a 4-year exploration project, scheduled for completion in 1978, and may earn a 40% interest in the share of M.I.M. Holdings Ltd. As a result of continued exploration, reserves increased to 500 million tons at 0.50% copper, as of June 1977.

Dampier dropped out of a consortium studying the Yandera copper-molybdenum prospect in Madang Province. The operating company, Amdex Mining Ltd., comprised Triako Mines N.L. and Buka Minerals N.L., together holding 61%, and Kennecott Explorations (Australia), with 39%. As a result of continuing exploration drilling, ore reserves were increased to 338 million tons at 0.40% copper.

On Manus Island, 360 kilometers north of the Papua New Guinea mainland in the Admiralty Islands Group, joint venture exploration by Exoil N.L. and Transoil N.L. indicated 160 million tons of ore at 0.32% copper, associated with gold, silver, and molybdenum, in one of several known prospects. These copper prospects had advantages in lower estimated development costs because of relatively good accessibility compared with mainland deposits.

In April, the Office of Minerals and Energy announced invitations to competitive bids for prospecting rights to the Tifalmin area, near the OK Tedi deposit. Any agreement would be with the Government's OK Tedi consortium and would require a $4.5 million exploration expenditure in 2 years.

Gold and Silver.—Gold continued to be an important byproduct at BCL's Panguna copper mine where gold recovery was important to the mine's viability. Gold sales totaled 718,023 troy ounces, down from that of 1976, from ores containing an average of 0.018 troy ounce per ton. Byproduct silver recovery was also lower.

New Guinea Goldfields Ltd., an Australia-based company, produced relatively small quantities of gold at Wau, where ore averaged 0.08 troy ounce per ton. The OK Tedi Copper Prospect was reported to contain 0.025 troy ounce of potentially recoverable gold per ton.

Mineral Fuels.—*Petroleum.*—In petroleum exploration, Esso Papua New Guinea Inc. drilled one offshore well in the Gulf of Papua and planned another well in the Fly River Delta area. Esso was operator for a joint venture also including Arco Australia Ltd., Australian Superior Oil Co. Ltd., Canadian Superior Oil (Australia) Pty. Ltd., and Sunray Australian Oil Co. Inc. The Papua New Guinea Government had an option for a direct interest of 22.5% in any potential commercial discovery. In April, Esso terminated an unsuccessful well in the Gulf of Papua, near Daru, at 3,434 meters, and planned to shift to the Fly River Delta area following seismic work there.

Legislation was passed, setting the basis for agreements between foreign petroleum companies and the Papua New Guinea Government on petroleum exploration. Ac-

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cording to an agreement negotiated with seven U.S.-based oil companies, the Government would receive 60% to 80% of any future revenues from oil or gas production, a 1.25% royalty based on wellhead values, a petroleum income tax of 50% of taxable income, a profits tax after an agreed rate of return is achieved, and a Government equity up to 22.5% with payment from the Government's share of production.

TONGA

Webb Tonga, a subsidiary of Webb Resources of Colorado, a U.S. independent oil company, planned a drilling program for oil onshore and offshore of Tongatapu, the island center of the Kingdom of Tonga. Webb Tonga was granted a lease and conducted a seismic survey in 1976, applied for and received an extension to its concession in 1977, and planned drilling for oil in 1978.

[1]Supervisory physical scientist, Branch of Foreign Data, (now retired).

[2]In October 1977, the Solomon dollar ($S) was introduced, initially on par with the Australian dollar. Where necessary, values have been converted to U.S. dollars at a rate of $S1 = US$1.11, the exchange rate of the Australian dollar.

[3]Where necessary, values have been converted from Fijian dollars (F$) to U.S. dollars at the rate of F$1 = US$1.14.

[4]Report of the Mines Section, Mineral Resources Division, Ministry of Lands and Mineral Resources, for the year 1977, Suva.

[5]Where necessary, values have been converted from Communauté Financière Pacifique Francs (CFPF) at a rate of CFPF89.11 = US$1.00.

[6]Joint Office of Development Planning. Factors Affecting the Choice of Development Objectives, Vila, New Hebrides. 1977, 73 pp.

[7]Where necessary, values have been converted from the Papua New Guinea Kina (K) to U.S. dollars at the rate of K1 = US$1.30, the exchange rate at yearend 1977.

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